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THE ERIGONINE SPIDERS OF NORTH AMERICA. PART 2. THE GENUS *SPIREMBOLUS* CHAMBERLIN (ARANEAE: LINYPHIIDAE)

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ABSTRACT

A revision of the North American erigonine genus *Spirembolus* Chamberlin is reported. *Tortembolus* Crosby and *Bactroceps* Chamberlin and Ivie are synonymized with *Spirembolus*. "*Erigone*" *chilkatensis* Chamberlin and Ivie has been transferred to *Spirembolus*, while *Spirembolus chera* Chamberlin and Ivie, *S. cheronis* Chamberlin, *S. oreinoides* Chamberlin, *S. vasingtonus* Chamberlin (*nomen nudum*) and *Tortembolus approximatus* Chamberlin have been excluded from the genus. *Spirembolus orthus* Chamberlin is a synonym of *S. whitneyanus*. The genus *Spirembolus* is defined in this paper mainly on the basis of certain features in the structure of the male palpal organs; these palpal characters indicate that the genus is probably monophyletic. The female genitalia also show common characters. The revised genus contains 38 species, including the following 20 new taxa: *Spirembolus abnormis, S. dispar, S. elevatus, S. erratus, S. falcatus, S. fuscus, S. hibernus, S. humilis, S. latebricola, S. levis, S. mendax, S. mirus, S. montivagus, S. novellus, S. praelongus, S. prominens, S. proximus, S. pusillus, S. tiogensis* and *S. venustus*. The genus is sub-divided provisionally into three species groups, the *monticolens*, *spirotubus* and *tortuosus* groups. The genus appears to be limited to the western half of North America, but biological data are scarce. Descriptions, diagnoses and distribution maps are given for each species.

INTRODUCTION

As part of a programme of study of the North American erigonine fauna, the genus *Spirembolus* Chamberlin 1920 has been revised. The American Museum of Natural History, New York (AMNH) was the most important source of material for this study; much of this material had been provisionally sorted into genera, and sometimes species, by the late W. Ivie. Smaller amounts of material from the Museum of Comparative Zoology, Harvard University (MCZ) and from the Canadian National Collection, Ottawa, were also examined.

In the present revision the genera *Tortembolus* Crosby 1925 and *Bactroceps* Chamberlin and Ivie 1945 have been synonymized with *Spirembolus*, for reasons given later in this paper. The genus *Spirembolus* (in its original scope) has not been revised since 1945 (Chamberlin and Ivie 1945), while the genera *Tortembolus* and *Bactroceps* have not been revised since their original descriptions.

The genus *Disembolus* Chamberlin and Ivie 1933, said (Chamberlin and Ivie 1945) to be close to *Spirembolus*, is quite distinct and will be dealt with in a later paper.

GENUS *SPIREMBOLUS* CHAMBERLIN

Spirembolus Chamberlin 1920:197
Tortembolus Crosby 1925:115. NEW SYNONYMY
Bactroceps Chamberlin and Ivie 1945:223. NEW SYNONYMY

Type species.—*Cornicularia monticolens* Chamberlin 1919

Definition.—The members of this genus are small spiders with a total length of about 1-3 mm. The female carapace is unmodified, but in the male there are several different forms (e.g. Figs. 35, 137, 178). Where there is a distinct lobe present there are also holes behind the lateral eyes; the lobe does not carry the posterior median eyes. The eyes show no peculiarities except that in some males which have a lobe on the carapace they take up a *Pholcomma*-like configuration (Fig. 193). All the species have a file on the lateral margins of the chelicerae in both sexes. The abdomen is clothed with short hairs and is without scuta; in most cases it is more or less unicolorous, usually grey to black, but in a few species it has a clear dorsal pattern of white or pale colored bars or chevrons (Fig. 141). In some species there are clear striations on the epigastric plates (lung covers), usually more developed in the male than in the female; the coxae IV are equipped with tiny spurs, presumably for engaging these stridulatory files. The spur is often present, however, even in those species lacking the file. The legs are relatively short and stout, with a value for tibia I 1/d (females) of ca. 5 (range 4-7); the larger species tend to have the thinner legs. The legs have tibial spines (macrosetae) 2221 in the female (for definitions of formulae used, see Part 1: Millidge, 1980), most frequently reduced to 0021 or 0011 in the male; there are a few exceptions, e.g. *S. bilobatus* (Chamberlin and Ivie), which in most respects is close to other members of the genus, has tibial spines 1111 in the female. Metatarsi I-III have a trichobothrium, which is absent on metatarsus IV; the value of TmI is unusually variable from species to species within the genus, having a range of 0.35-0.80. In many of the species the first and second pairs of legs of the male have short curved hairs on the tibia and metatarsus (particularly on the dorsal side): these hairs are less developed or absent in some of the smaller species. The femur of the male palp is long, and the patella is often long also (e.g. Figs. 48, 65); but in some of the smaller species the patella is much shorter (Fig. 176). The males of a few species have a white bubble-like excrescence arising from the joint between the palpal femur and patella (Fig. 40). The palpal tibia of the male usually has a long apophysis, straight or curved, narrowed distally and with a small hook at the distal end (e.g. Figs. 1, 126); in addition, there is in many species a lower (inferior) apophysis (I, Fig. 30). The palpal tibia has 1, 2 or 3 trichobothria dorsally in the male, and 2 or 3 in the female (Figs. 132, 7, 30; 15, 38); when the female tibia has 3, the male tibia normally has 3 also, and when the female has 2 the male has 2 or 1. It is notable that in one species (*S. pachygnathus* Chamberlin and Ivie) the right tibia of the female has 3 trichobothria while the left has 2. The cymbium of the male palp is conical to a greater (Fig. 103) or lesser (Fig. 133) degree.

In common with most erigonines, the structure of the *Spirembolus* species is so generalised that it is impossible on the basis of known somatic characters either to define the genus or to differentiate it satisfactorily from related genera. The genus must therefore be characterised chiefly on the structure of the male palpal organ, which will now be described.

The paracymbium is elongate (Figs. 29, 48), somewhat as in the genus *Ceraticelus* Simon, but is less so in some of the smaller species (e.g. Fig. 189). The embolic division

(ED) consists of a spiral embolus of several turns (E, Fig. 32) with a short coiled tailpiece (T, Fig. 32); the coils of the tailpiece are less developed in some of the smaller species (e.g. Fig. 129). The sperm duct (made visible by clearing the palp in clove oil) runs down from near the anterior end of the suprategulum via the membraneous stalk to enter the ED from the mesal side, anterior to the tailpiece. The ED is of the same form in all species of the genus, but the embolus ranges from very long, with the terminal part thin and hairlike and forming a wide coil (e.g. Fig. 115), to short, with the distal part stouter and in a small coil (e.g. Fig. 95). In a few species the duct in the stalk runs posteriorly through one turn of the embolic coil before entering the embolus (Fig. 32). The suprategular apophysis (SA) is a membraneous ribbon which arises from the anterior (distal) end of the suprategulum but also has a membraneous connection with the stalk; there is a sclerotized strengthening section at its basal end where the SA arises from the suprategulum. The general form of the SA is shown in Figs. 29, 46; it runs in a curve along the anterior margin of the cymbium and then down the anterior edge of the tegulum on the ectal side. In living males the terminal part of the embolus probably rests on the SA, but is often detached from it in preserved specimens. The SA is of the same general form in all the species (Figs. 2, 46, 167, 180), but in those species with a short embolus it is shorter (Fig. 95). A small tongue-like membraneous apophysis arises from the surface of the tegulum near the base of the suprategulum (M, Fig. 46); this is present in all the species, but in many it is small and more or less hidden behind the ED. From other genera which have a coiled embolus and a coiled screw-like tailpiece (e.g. *Cochlembolus* Crosby, *Coreorgonal* Bishop and Crosby, etc. which will be dealt with in a following paper), *Spirembolus* is distinguished by the following characters: (i) the shape of the tailpiece: in some of the smaller *Spirembolus* species this is rather close to that in other genera; (ii) the form of the SA; (iii) the presence of the small tegular apophysis; (iv) the shape of the paracymbium. The characters (i) - (iii) are probably unique to the genus and are almost certainly apomorphic (derived); their presence in all the species supports the hypothesis that the genus as here constituted is monophyletic (Hennig 1966).

The female epigyna are all similar in form. Posteriorly there is a transverse chitinous plate, anterior to which the outlines of the spermathecae and internal ducts can be seen with a variable degree of clarity (e.g. Figs. 11, 56). Although the genus cannot be satisfactorily *defined* on the form of the epigynum, it is nevertheless possible with experience to *recognize* a *Spirembolus* female in most instances. The internal genitalia of the female (examined by clearing the excised epigynum, or occasionally the whole spider, in clove oil) appear to be similar in basic pattern in all the species. The sperm duct arises from an opening with thickened walls more or less on the mesal side of the spermatheca, and then follows a helical path around the dorsal to the ventral side of the spermatheca. Usually the helix is of one turn only (e.g. Fig. 58), but in some species having a long embolus there are several turns and/or additional convolutions (e.g. Fig. 22). In the case of some closely related species which form a series with decreasing lengths of emboli (e.g. *S. prominens*, new species, *S. monticolens* (Chamberlin) and *S. pachygnathus*: Figs. 6, 1, 4) the female genitalia show a corresponding reduction in the length and arrangement of the sperm duct (Figs. 22, 17, 20). In *S. erratus*, new species, and two related species, where the embolus is long to very long, the greatly lengthened sperm duct forms a helix of several turns (Fig. 165). These findings confirm that not only can the length of the male embolus increase or decrease substantially within a single genus but that the length of the sperm duct in the female can vary in a similar fashion.

The entrances to the sperm ducts leading to the spermathecae seem to be situated within the shallow depressions which are faintly visible (though often difficult to see) on

the epigynal plate (O, Figs. 104, 110). As is probably normal in the erigonines, the plate is folded under from the ventral to the dorsal side, forming a semi-transparent sclerotized envelope sealed at the sides but open anteriorly (on the inside) to the atrium. One female (probably of *S. spirotubus* (Banks)) had a broken-off embolus in the atrium, but this had been inserted under the side of the plate and was twisted erratically within the atrium. So far as could be ascertained, there are no entrances to the spermathecal ducts except from the ventral side of the plate. A broken-off embolus inside a female may thus not always be a reliable guide to the route of the spermathecal duct; it seems likely in the present case that the embolus had broken off because it had been inserted in the wrong position and become jammed behind the plate. Because of the transparency of the ducts, due to lack of pigmentation in some parts, it has not been possible in any species to trace with certainty the total pathway by which the embolus reaches (or approaches) the spermatheca from the external opening.

The generic names *Tortembolus* and *Bactroceps* are considered to be junior synonyms of *Spirembolus*. Only the form of the male carapace (a character which tends to be variable in other erigonine genera) would distinguish these genera from *Spirembolus*. The chaetotaxy (tibial spines and metatarsal trichobothria) of the *Tortembolus* and *Bactroceps* species is, with few exceptions, the same as in *Spirembolus*. In all three genera the male palpal organs are of closely similar pattern, with the same form of SA (Figs. 2, 46, 167, 180), and with similar ED's; the tailpiece in these smaller species tends to be more compressed than in the larger *Spirembolus* species, but in *T. fasciatus* (Banks) it is of the normal form (Fig. 150). The small tegular apophysis present in the *Spirembolus* males is also present in *Tortembolus* and *Bactroceps* (Figs. 167, 180). The female genitalia of *Tortembolus* and *Bactroceps* species also have the same general form as those of *Spirembolus*; this is illustrated by comparisons of *B. redondo* Chamberlin and Ivie (Fig. 188) with *S. perjucundus* (Fig. 73), of *B. bilobatus* Chamberlin and Ivie (Fig. 187) with *S. hibernus*, new species (Fig. 83) and of *T. fasciatus* (Fig. 159) with *S. humilis*, new species (Fig. 74). The stridulatory files on the epigastric plates, which are well developed in some *Tortembolus* species, are also present, albeit in weaker form, in a few of the *Spirembolus* species (e.g. *S. phylax* Chamberling and Ivie, male).

The species "*Erigone*" *chilkatensis* Chamberlin and Ivie has also been moved into *Spirembolus*, on the evidence of the genitalia.

It is of interest to note that the species with the patterned abdomens (previously in *Tortembolus*) have in several instances a sibling form which has a unicolorous abdomen, but is otherwise closely similar. These distinct color forms, which have sometimes been found in the same localities as the unicolorous forms, are here regarded as separate species; biological data are needed to test this view. In the populations of *S. demonologicus* (Crosby) (unicolorous abdomen) and *S. pusillus*, new species (the sibling species with patterned abdomen) there are present in each case three distinct forms of the male carapace. In this paper it is assumed that the males of these two species are polymorphic, but it is perhaps not impossible that there are three species present in each of these populations; only one structurally recognizable female is present in each case.

The genus *Spirembolus* seems to have undergone rather vigorous speciation, in many instances accompanied by only minor structural change. Distinctions between species may rest, for example, on the diameter of the embolic coil, on the form of the male carapace, on the presence or absence of epigastric files, and on the presence or absence of an abdominal pattern. The structural differences, though often small, appear to be discrete: there seem to be no intermediates between the populations bearing these

characters. The existence of only small differences between some species results in a somewhat troublesome taxonomy. The females of a few species cannot be identified with certainty if captured without the corresponding male.

Examination of the types of all the previously described species shows that there has been confusion in the past over the identity of a few of the species. *S. spirotubus* (Banks) and *S. vallicolens* Chamberlin were completely confused by Chamberlin and Ivie (1945), while the *S. perjucundus* figured in the same paper is not *S. perjucundus* Crosby. In the key given by Crosby (1925) to the *Tortembolus* species only one species with a patterned abdomen was recognized (*T. fasciatus*), and probably in consequence all the patterned specimens in the AMNH Collection were labelled "*T. fasciatus*". In fact there are at least seven species which have the abdominal pattern, and most of the labelled specimens were wrongly identified.

Species.—The genus as defined in this paper contains 38 species, which are listed in Table 1. The holotype of *S. montivagus*, new species is deposited in MCZ; the holotypes of all the remaining new species are deposited in AMNH. All other specimens of the new species examined during this study rank as paratypes and are labelled as such; with few exceptions, these also are deposited in AMNH.

Species Groups—The species can be placed provisionally in three species groups, as shown in Table 1. These groups are as follows:

1. The *monticolens* group contains species with the following characters: two trichobothria are present on the palpal tibia (both sexes); the male palpal tibia lacks the inferior apophysis (e.g. Fig. 7); the curved hairs on the anterior legs of the male are only weakly developed.

2. The *spirotubus* group contains species with the following characters: three trichobothria are present on the palpal tibia (in both sexes); the male palpal tibia has an inferior apophysis in most cases (e.g. Fig. 30); the males have well developed curved hairs on the anterior legs.

3. The *tortuosus* group contains those species previously placed in *Tortembolus* and *Bactroceps* and related new species. They have the following characters: two trichobothria are present on the palpal tibia of the female, and one or two in the male (but *S. bilobatus* and *S. redondo* females sometimes have three); the males have a well developed lobe (or lobes) on the carapace with a hole behind the lateral eyes (e.g. Fig. 130); the male palpal tibia lacks the inferior apophysis (e.g. Fig. 157); the curved hairs on the anterior legs of the male are absent or very weakly developed; some species have a patterned abdomen; some species have strongly developed files on the epigastric plates.

These species groups may not be phylogenetically pure.

Misplaced Species—The following species do not belong in *Spirembolus*:

Spirembolus chera Chamberlin and Ivie 1933:20

This was synonymized, erroneously, with *Disembolus stridulans* Chamberlin and Ivie (Chamberlin and Ivie 1945); it will be dealt with in a later paper.

Spirembolus cheronus Chamberlin 1948:546

The type of this species has not been found, but from the figures given of the epigynum it cannot be a *Spirembolus*.

Spirembolus oreinoides Chamberlin 1948:546

The female holotype of this species has been examined; it is not a *Spirembolus*.

Spirembolus vasingtonus Chamberlin 1948: Fig. 82

Under Article 13(a) of I.C.Z.N. Rules this name is a nomen nudum. The material is easily recognized, however, and both sexes are present in the AMNH Collection. It is most certainly not a *Spirembolus*.

Tortembolus approximatus Chamberlin 1948:557

This is an easily recognized species, which does not belong in *Spirembolus*.

Species Descriptions—These are given in the order shown in Table 1. All figures of palps are of the right palp.

Distribution and Natural History.—The genus *Spirembolus* is limited to western North America, with records from Mexico to Alaska; the most easterly record is in Colorado (longitude 104° W). The majority of the records are from California, possibly only because this has been a popular area for collecting: of the 38 species described, 30 are

Table 1.—Genus *Spirembolus*: list of species. The species are described in the text in the order given. For definitions of the species groups see text.

monticolens species group
S. monticolens (Chamberlin)
S. pachygnathus Chamberlin and Ivie
S. prominens, new species
S. pallidus Chamberlin and Ivie
S. maderus Chamberlin
spirotubus species group
S. spirotubus (Banks)
S. vallicolens Chamberlin
S. synopticus Crosby
S. proximus, new species
S. montivagus, new species
S. phylax Chamberlin and Ivie
S. perjucundus Crosby
S. humilis, new species
S. mendax, new species
S. hibernus, new species
S. falcatus, new species
S. tiogensis, new species
S. whitneyanus Chamberlin and Ivie
S. venustus, new species
S. chilkatensis (Chamberlin and Ivie), new combination
S. mundus Chamberlin and Ivie
S. latebricola, new species
S. elevatus, new species
S. dispar, new species
S. abnormis, new species
tortuosus species group
S. tortuosus (Crosby), new combination
S. fuscus, new species
S. demonologicus (Crosby), new combination
S. pusillus, new species
S. levis, new species
S. fasciatus (Banks), new combination
S. novellus, new species
S. erratus, new species
S. monicus (Chamberlin), new combination
S. praelongus, new species
S. bilobatus (Chamberlin and Ivie), new combination
S. redondo (Chamberlin and Ivie), new combination
S. mirus, new species

known to be present in California. When other western States have been equally well worked, there is little doubt that additional new species will be discovered.

Information on the natural history of the *Spirembolus* species is sparse indeed: only in very rare instances is any indication of the type of habitat to be found on the vial labels or in previous publications. It seems probable that, like most erigonines, the species are ground living, but may occasionally be found on low herbage.

Keys to Species.–Partial keys have been drawn up for the species (Tables 2 and 3). With genera like *Spirembolus*, where there are numerous species exhibiting rather small structural differences, purely dichotomous keys are not only difficult to draw up and tiresome to use, but are likely in unskilled hands or if used uncritically to lead to false identifications. In the author's view, it is preferable in such cases to have partial keys in which the reader is directed, by a tabular presentation, to groups of species which share one or more characters; after which, for final identification, it is necessary (in most cases) to refer to the species descriptions. It is practically certain that further new species of *Spirembolus* will be collected, and these are more likely to be recognized as such when a partial key of this kind is used for diagnosis.

Spirembolus monticolens (Chamberlin)
Figures 1,2,3,7,9,11,13,15,17; Map 1

Cornicularia monticolens Chamberlin 1919: 251
Spirembolus monticolens: Chamberlin 1920: 197; Crosby 1925: 113; Chamberlin and Ivie 1933: 18, 1945: 217; Roewer 1942: 665; Bonnet 1958: 4122

Holotype.–Male holotype from Chalk Creek, Uintah Mts., Utah, August 1917 (R. V. Chamberlin); in MCZ, examined.

Description.–Total length: female 1.7-1.9 mm, male 1.6-1.7 mm. Carapace: Length: female 0.80 mm, male 0.70-0.75 mm. Chestnut brown with dusky markings and margins. Male carapace raised anteriorly and projecting over clypeus (Figs. 9, 13). Chelicerae: rather swollen anteriorly in male (Fig. 13). Abdomen: grey to black. Sternum: orange-brown, suffused with black. Legs: brown. Tibial spines: female 2221, male 0011; TmI: female 0.47-0.50, male 0.45-0.47. Male palp: Figs. 1,2,3,7. Female palp: tibia with 2 trichobothria (Fig. 15). Epigynum: Figs. 11, 17; the posterior plate is relatively broader than in most other species.

Diagnosis.–In the male, the carapace shape (Fig. 9), coupled with the form of the palpal tibia (Fig. 7), distinguish this species from all others except *S. pachygnathus* and *S. prominens*. From these two latter species, *S. monticolens* is separated by the diameter of the embolic coil, which is smaller in *S. pachygnathus* and larger in *S. prominens* (Fig. 1 cf. Figs. 4, 6). In the female, the epigynum distinguishes *S. monticolens* (with *S. pachygnathus* and *S. prominens*) from the other species which have two trichobothria on the palpal tibia. *S. monticolens* female is separated from *S. pachygnathus* by the internal genitalia (Fig. 17 cf. Fig. 20); these two species are usually separable also by the presence in *S. pachygnathus* of three trichobothria on the right palpal tibia. *S. monticolens* is distinguished from *S. prominens* by the genitalia, the ducts in the latter species being stouter and with a different configuration (Fig. 17 cf. Fig. 22); these two species may also be separable by the epigyna, the internal ducts being more visible through the integument in *S. prominens* (Fig. 11 cf. Fig. 12).

Table 2.—Partial key to *Spirembolus* species: males. A decision on species identity should be made only after reference to the species descriptions and diagnoses.

1. Carapace raised anteriorly into two lobes (Figs. 178, 179)
   S. bilobatus, S. redondo
2. Carapace raised into small lobe (Fig. 191)
   S. mirus
3. Carapace raised into distinct lobe (Figs. 138, 163), with hole behind lateral eyes
   a. Abdomen unicolorous
      i. Epigastric plates smooth
         S. tortuosus
      ii. Epigastric plates striated
         S. demonologicus, S. monicus (separation by form of carapace and palps)
   b. Abdomen with clear pattern of white bars/chevrons
      i. Epigastric plates smooth
         S. levis, S. fasciatus (separation by form of carapace and palps)
      ii. Epigastric plates striated
         S. pusillus, S. novellus, S. erratus, S. praelongus (separation by form of carapace and palps)
4. Carapace raised anteriorly, to a greater or lesser degree, but not into distinct lobe (e.g. Figs. 13, 66, 67): see Sections 5-7
5. TmI 0.60-0.80. Palpal tibia with 3 trichobothria (Fig. 38)
   S. mundus, S. latebricola, S. elevatus, S. dispar, S. abnormis (separation by form of carapace, palpal tibia, palpal organs, color and value of TmI)
6. TmI 0.5 or less. Palpal tibia with 2 trichobothria (Fig. 15), and lacking inferior apophysis
   a. Male carapace projecting anteriorly (Figs. 9, 13)
      S. monticolens, S. pachygnathus, S. prominens (separation by palpal organs)
   b. Male carapace not projecting anteriorly (Fig. 28)
      S. pallidus, S. maderus (separation by palpal organs)
7. TmI 0.5 or less. Palpal tibia with 3 trichobothria (Fig. 38) and usually with inferior apophysis (e.g. Fig. 30)
   a. Carapace steeply raised anteriorly (Figs. 66, 68)
      S. perjucundus, S. mendax (separation by palpal organs)
   b. Carapace less steeply raised
      i. Palpal organs with small short coil (Fig. 95)
         S. whitneyanus
      ii. Palpal tibia of general form shown in Fig. 30; palp with white excrescence between femur and patella
         S. spirotubus, S. vallicolens, S. synopticus, S. proximus, S. montivagus (closely related species: for separation, see species descriptions and diagnoses)
      iii. Palpal tibia as in Figs. 86, 92, but without white excrescence between femur and patella
         S. falcatus, S. tiogensis (for separation, see species descriptions and diagnoses)
      iv. Palpal tibia as in Figs. 64, 81
         S. humilis, S. hibernus (for separation, see species descriptions and diagnoses)
      v. Palpal tibia lacking inferior apophysis (Fig. 54)
         S. phylax

Table 3.–Partial key to *Spirembolus* species: females. A decision on species identity should be made only after reference to the species descriptions and diagnoses.

1. Abdomen dorsally with well defined white bars/chevrons
   a. Epigastric plates with striae (sometimes rather weak)
      S. pusillus, S. novellus, S. erratus (some specimens), *S. praelongus* (for separation, see species descriptions and diagnoses)
   b. Epigastric plates smooth
      S. fuscus, S. levis, S. fasciatus, S. erratus (most specimens) (for separation, see species descriptions and diagnoses)
2. Abdomen unicolorous: see Sections 3-7
3. Epigastric plates striated
      S. demonologicus, S. monicus (separation by epigyna: see species descriptions and diagnoses)
4. Tibial spines 1111. TmI ca. 0.55
      S. bilobatus
5. Tibial spines 2221. TmI ca. 0.60-0.80
      S. mundus, S. latebricola, S. dispar, S. abnormis (separation by size, color, epigyna and value of TmI: see species descriptions and diagnoses)
6. Tibial spines 2221. TmI 0.5 or less. Palpal tibia with 2 trichobothria (Fig. 15). Note: *S. pachygnathus* has 2 trichobothria on left palpal tibia but usually 3 on right
   a. Dark colored spiders; epigynum of form shown in Fig. 11
      S. monticolens, S. pachygnathus, S. prominens (for separation, see species descriptions and diagnoses)
   b. Lighter colored spiders; epigynum of form shown in Figs. 25, 26
      S. pallidus, S. maderus (for separation, see species descriptions and diagnoses)
   c. Epigynum of form shown in Fig. 127; small spider, length ca. 1.30-1.40 mm
      S. tortuosus
   d. Epigynum of form shown in Fig. 186
      S. redondo (this species sometimes has 3 trichobothria on the palpal tibia: hence see also Section 7 of this Key)
7. Tibial spines 2221. TmI 0.55 or less. Palpal tibia with 3 trichobothria (Fig. 38), one of which is smaller and sometimes rather inconspicuous
   a. Epigynum Fig. 52
      S. proximus
   b. Epigynum Fig. 98
      S. venustus
   c. Epigynum Fig. 100
      S. chilkatensis
   d. Epigynum Fig. 93
      S. whitneyanus
   e. Epigynum Fig. 186
      S. redondo

   The remaining species in this section are less easy to diagnose. The epigyna fall into two groups:
   f. Epigynum Fig. 31
      S. spirotubus, S. vallicolens, S. synopticus, S. montivagus (for separation, see species descriptions and diagnoses)
   g. Epigyna Figs. 56, 69, 70, 71, 72, 79, 82, 88
      S. phylax, S. perjucundus, S. humilis, S. mendax, S. hibernus, S. falcatus (for separation, see species descriptions and diagnoses)

Distribution.—*S. monticolens* is one of the most widely distributed of the *Spirembolus* species; it has been recorded from Utah, Wyoming, Nevada, Idaho, California, Oregon, Washington and British Columbia (Map 1).

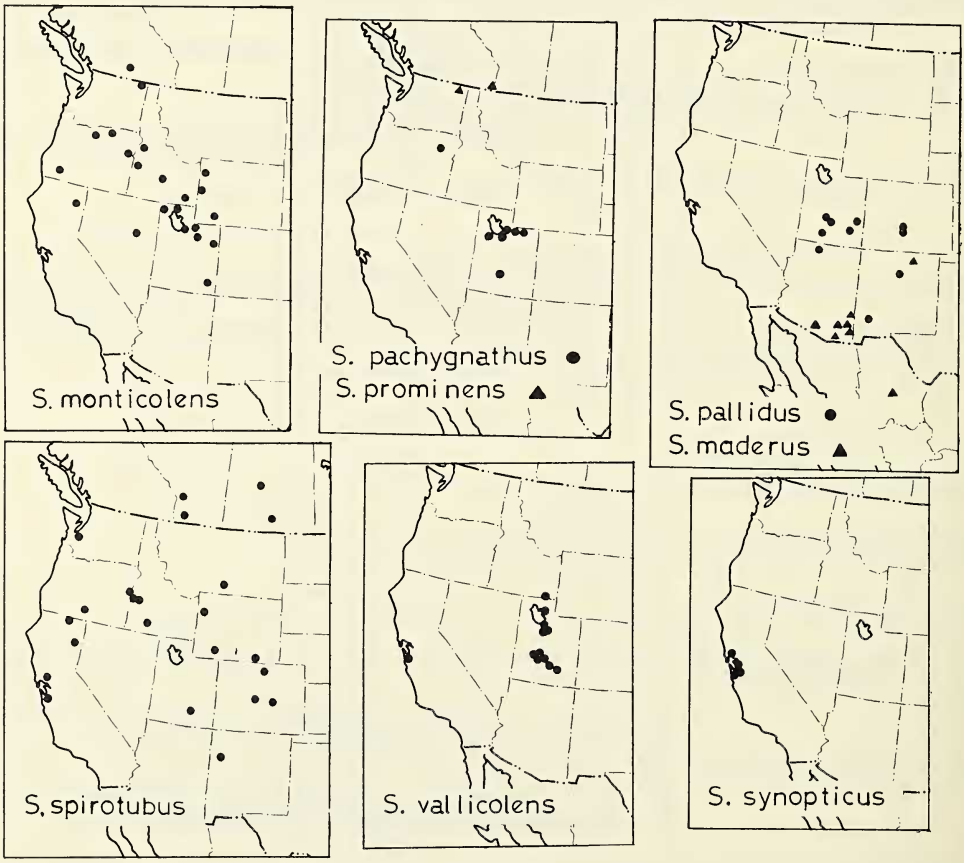
Natural History.—Males and females have been taken in April, May, June, July, August, September, October and November. The main maturity period would seem to be in summer. The only habitat recorded is among dead leaves.

Spirembolus pachygnathus Chamberlin and Ivie
Figures 4, 5, 16, 20; Map 1

Spirembolus pachygnathus Chamberlin and Ivie 1935: 18, 1945: 218; Roewer 1942: 666; Bonnet 1958: 4123

Holotype.—Male holotype from Fish Lake, Sevier County, Utah, September 4, 1929 (R. V. Chamberlin); in AMNH, examined.

Description.—Total length: female 1.9-2.1 mm, male 1.7-1.8 mm. Carapace: length: female/male 0.90 mm. Apart from its slightly larger size, this species closely resembles *S.*

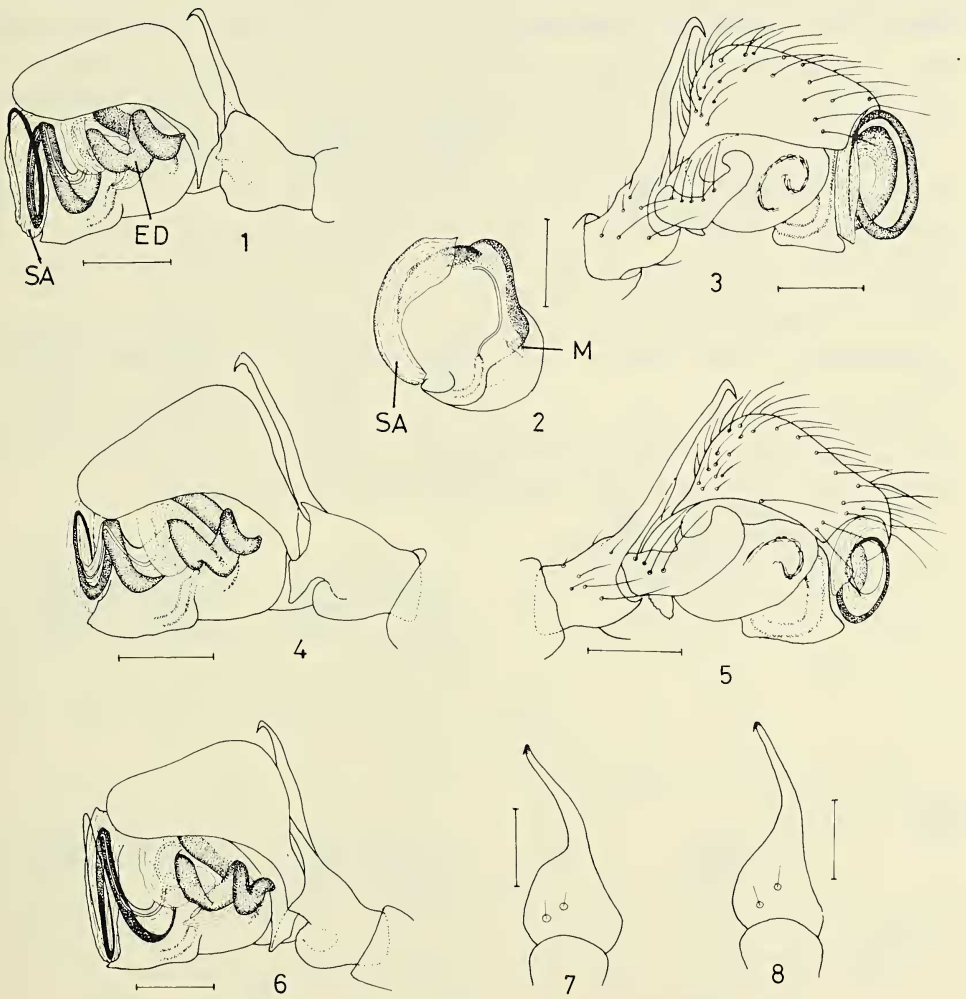


Map 1.—Western North America: distributions of *S. monticolens, S. pachygnathus, S. prominens, S. pallidus, S. maderus, S. spirotubus, S. vallicolens* and *S. synopticus.*

monticolens. Male palp: Figs. 4, 5; the embolic coil is relatively small in diameter. Female palp: the left palpal tibia usually has 2 trichobothria while the right has 3. Epigynum: not distinguishable from that of *S. monticolens*. Internal genitalia Fig. 20.

Diagnosis.–The male of this species is readily separated from *S. monticolens* and *S. prominens* by the smaller diameter of the embolic coil (Fig. 4 cf. Fig. 1). The female is distinguished from *S. monticolens* and from *S. prominens* by the internal genitalia (Fig. 20 cf. Figs. 17, 22) and usually also by the trichobothria on the palpal tibiae. Females taken without males should always be identified with caution, however.

Distribution.–This species is much less widely distributed than *S. monticolens*, with records from Utah and Oregon only (Map 1).



Figs. 1-8.–1, *S. monticolens*, male palp, mesal; 2, *S. monticolens*, male palpal organ, anterio-mesal, ED removed; 3, *S. monticolens*, male palp, ectal; 4, *S. pachygnathus*, male palp, mesal; 5, *S. pachygnathus*, male palp, ectal; 6, *S. prominens*, male palp, mesal; 7, *S. monticolens*, male palpal tibia, dorsal; 8, *S. prominens*, male palpal tibia, dorsal. Abbreviations: ED, embolic division; M, membraneous apophysis; SA, supratregular apophysis (Scale lines 0.1 mm).

Natural History.—Males have been recorded in March, April, June, August and September, females in February, April, June, August and September. Nothing is known on habitat.

Spirembolus prominens, new species
Figures 6, 8, 10, 12, 14, 22; Map 1

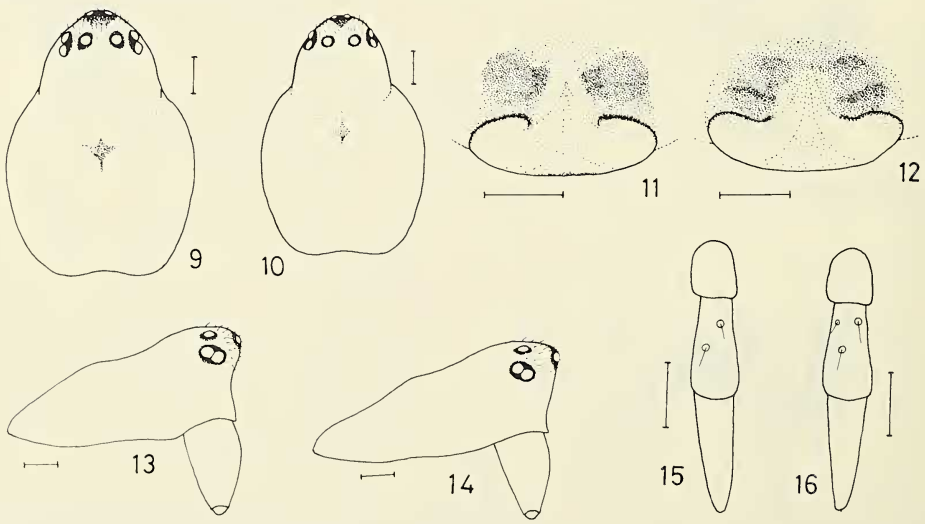
Holotype.—Male holotype from Cedar Lake, Stevens County, Washington, September 30, 1964 (J. and W. Ivie); deposited in AMNH.

Description.—Total length: female 1.75-1.80 mm, male 1.60 mm. Carapace: length: female 0.75-0.80 mm, male 0.75 mm. Brown, with dusky markings and margins. The male carapace projects anteriorly as in *S monticolens* (Fig. 10. 14). Chelicerae: rather swollen anteriorly in male. Abdomen: grey to black. Sternum: brown, suffused with black. Legs: brown. Tibial spines: female 2221, male 0211, but weak on legs II. TmI: female 0.42-0.48, male 0.47. Male palp: Figs. 6, 8; the embolus is in a large coil. Female palp: tibia with 2 trichobothria. Epigynum: Figs. 12, 22.

Diagnosis.—This species resembles *S. monticolens* and *S. pachygnathus* in most characters. The male of *S. prominens* is distinguished from these species by the larger diameter of the embolic coil, and by the narrower width of the ribbon-like part of the embolus (Fig. 6 cf. Figs. 1, 4). The female is separated by the epigynum, where the somewhat stouter internal ducts are visible through the integument (Fig. 12 cf. Fig. 11), and by the internal genitalia (Fig. 22 cf. Figs. 17, 20) (see also *S. monticolens* diagnosis).

Distribution.—Known only from Washington (type locality) and from Alberta, Canada (Map 1).

Natural History.—The males were taken in June (Alberta) and September (Washington), and the females in September (Washington). The Alberta specimen was taken in a pitfall trap in an open grassy area in coniferous woods at 1675 m altitude.



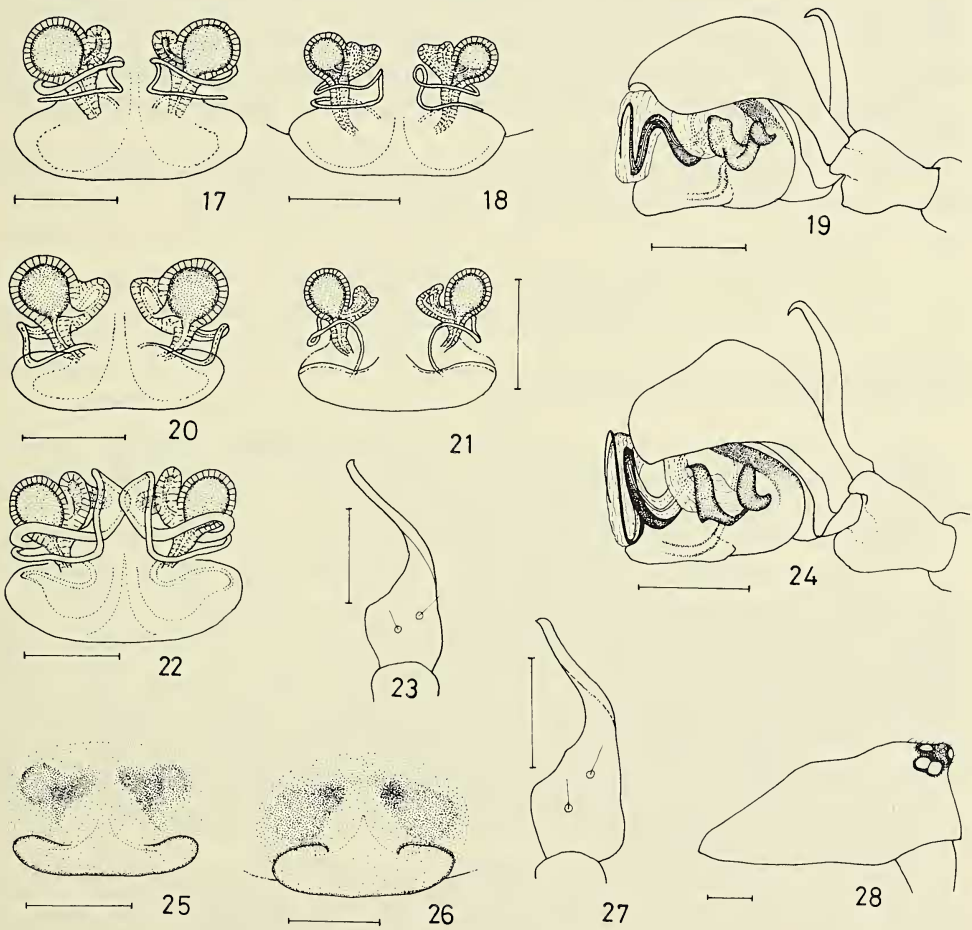
Figs. 9-16.—9, *S. monticolens*, male carapace, dorsal; 10, *S. prominens*, male carapace, dorsal; 11, *S. monticolens*, epigynum; 12, *S. prominens*, epigynum; 13, *S. monticolens*, male carapace, lateral; 14, *S. prominens*, male carapace, lateral; 15, *S. monticolens*, female palpal tibia and tarsus, dorsal; 16, *S. pachygnathus*, right hand female palpal tibia and tarsus, dorsal (Scale lines 0.1 mm).

Spirembolus pallidus Chamberlin and Ivie
Figures 19, 21, 23, 25, 28; Map 1

Spirembolus pallidus Chamberlin and Ivie 1935: 19, 1945: 223; Roewer 1942: 666; Bonnet 1958: 4123

Holotype.–Male holotype from Mount Ellen, Henry Mountains, Utah, September 11, 1929 (R. V. Chamberlin); in AMNH, examined.

Description.–Total length: female 1.55-1.65 mm, male 1.45-1.55 mm. Carapace: length: female 0.65 mm, male 0.60 mm. Pale brown to brown with faint dusky markings. Male carapace only slightly raised anteriorly (Fig. 28); the anterior median eyes are borne on a small prominence. Abdomen: whitish grey to grey, clothed with short hairs. Sternum: yellow to pale brown, darker on margins. Legs: pale brown to brown. Tibial



Figs. 17-28.–17, *S. monticolens*, internal genitalia, ventral; 18, *S. maderus*, internal genitalia, ventral; 19, *S. pallidus*, male palp, mesal; 20, *S. pachygnathus*, internal genitalia, ventral; 21, *S. pallidus*, internal genitalia, ventral; 22, *S. prominens*, internal genitalia, ventral; 23, *S. pallidus*, male palpal tibia, dorsal; 24, *S. maderus*, male palp, mesal; 25, *S. pallidus*, epigynum; 26, *S. maderus*, epigynum; 27, *S. maderus*, male palpal tibia, dorsal; 28, *S. pallidus*, male carapace, lateral (Scale lines 0.1 mm).

spines: female 2221, male 1121 but short and weak. TmI: female 0.35-0.40, male 0.35. Male palp: Figs. 19, 23; the embolus forms a rather small coil. The tibia is similar in general form to that of *S. monticolens*. Female palp: tibia with 2 trichobothria. Epigynum: Figs. 25, 21.

Diagnosis.—*S. pallidus* is one of the small group of species which have a unicolorous abdomen and two trichobothria on the palpal tibia. The male is separated clearly from *S. monticolens, S. pachygnathus* and *S. prominens* by its relatively pale colour, the form of the male carapace and the form of the palpal tibia (Fig. 23 cf. Figs. 7, 8). From the closely related species *S. maderus*, the male of *S. pallidus* is distinguished by the smaller diameter of the embolic coil (Fig. 19 cf. Fig. 24). The female of *S. pallidus* is separated from the other species in the group (except *S. maderus*) by its pale colour and the epigynum. The epigyna of *S. pallidus* and *S. maderus* though very similar are usually distinct (Fig. 25 cf. Fig. 26), but occasionally they may be difficult to distinguish. Supporting evidence is offered by the relatively stouter legs of *S. pallidus*, which has e.g. tibia I 1/d ca. 4, MTI 1/d ca. 6, cf. corresponding figures for *S. maderus* of 5 and 7. *S. pallidus* is normally (but probably not invariably) paler in color than *S. maderus*.

Distribution.—*S. pallidus* has been found so far only in Utah, Colorado and New Mexico (Map 1).

Natural History.—Males have been taken in April and September, females in April, May, July, September and October. There is no information on habitat.

Spirembolus maderus Chamberlin
Figures 18, 24, 26, 27; Map 1

Spirembolus maderus Chamberlin 1948: 547

Types.—Female holotype from Madera Canyon, Santa Rita Mts., Arizona, September 8, 1941 (W. Ivie); in AMNH, examined. The two "paratypes" from California mentioned by Chamberlin (1948) were found to be *S. hibernus*.

Description.—The male, which was taken with the female, is described for the first time. Total length: female 1.7-1.8 mm, male 1.45 mm. Carapace: length: female 0.80 mm, male 0.65 mm. Brown, with dusky markings and margins. Male carapace as in *S. pallidus*. Abdomen: grey to black. Sternum: brown suffused with black. Legs: brown. Tibial spines: female and male 2221, but spines much weaker in male. TmI: female 0.40-0.44, male 0.40. Male palp: Figs. 24, 27; very similar to that of *S. pallidus*, but the embolic coil is larger in diameter. Female palp: tibia with 2 trichobothria. Epigynum: Fig. 26; somewhat variable, and sometimes rather close to that of *S. pallidus*. The internal genitalia (Fig. 18) show the same differences from those of *S. pallidus* as is the case with *S. monticolens* / *S. pachygnathus*.

Diagnosis.—*S. maderus* is close to *S. pallidus* (q.v.). The males are distinguishable by the diameters of the embolic coil (Fig. 24 cf. Fig. 19). The separation of the females can be more difficult; the epigyna are usually sufficiently distinctive (Fig. 26 cf. Fig. 25), but occasionally the differences are less clear. The legs of *S. maderus* female are slightly less stout than those of *S. pallidus* (q.v.), and this can be used to check the identity of doubtful specimens. *S. maderus* is usually somewhat darker in color than *S. pallidus*.

Distribution.—This species has been taken in Arizona, New Mexico and Mexico, mostly at altitudes well above sea level (Map 1).

Natural History.–Males have been taken in May, June and July, females in May, June, July, August, September, October and December (Mexico). The chief period of maturity seems to be in summer. Nothing is recorded on habitat.

Spirembolus spirotubus (Banks)
Figures 29,30,31,32,33,35,36,38,42; Map 1

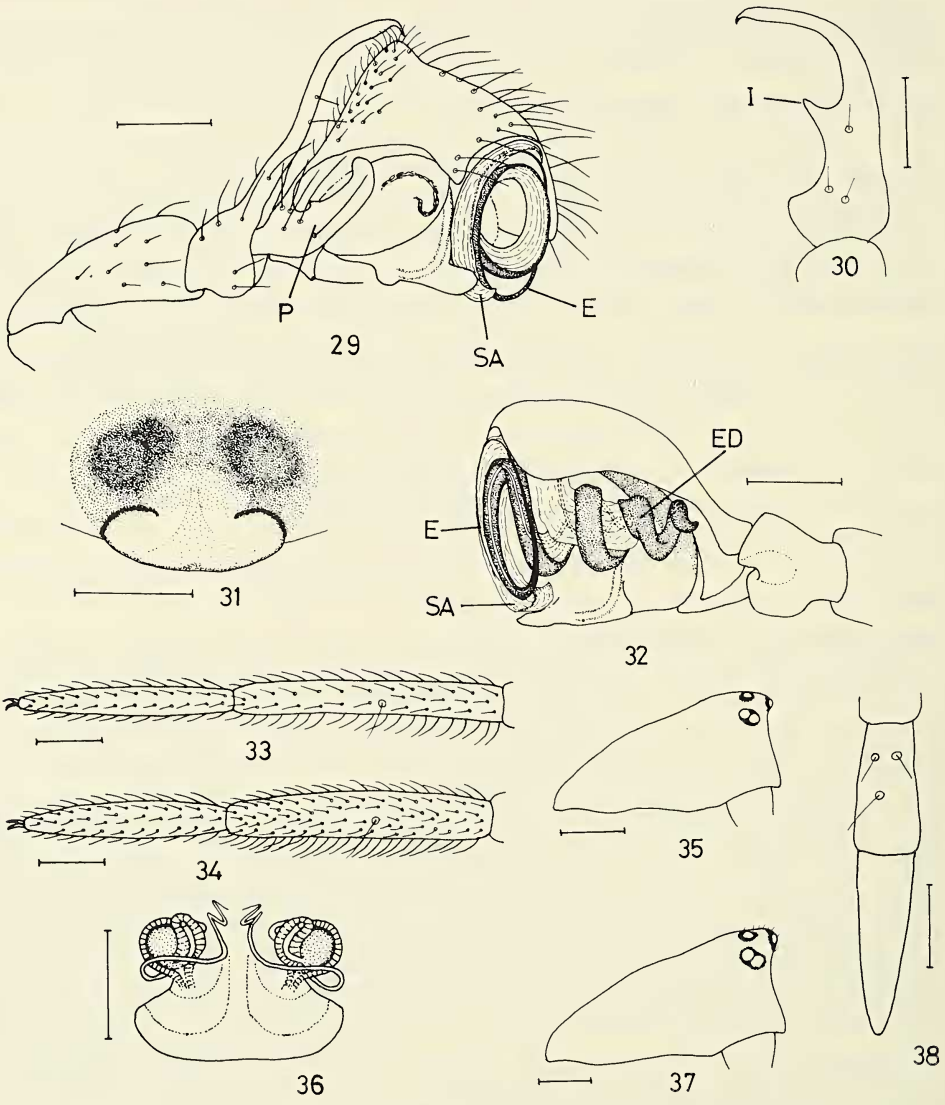
Tiso spirotubus Banks 1895: 424.
Spirembolus spirotubus: Crosby 1925: 113; Roewer 1942: 666; Chamberlin and Ivie 1945: 221
Spirembolus spiritubus: Bonnet 1958: 4123

Types.–Three males from Fort Collins, Colorado; in MCZ, examined.

Description.–Total length: female 1.9-2.0 mm, male 1.60-1.70 mm. Carapace: length: female 0.9 mm, male 0.75 mm. Deep brown, with dusky markings and margins. Male carapace smoothly elevated anteriorly, with clypeus not very concave (Fig. 35). Abdomen: black to grey. Sternum: deep brown to orange brown, suffused with black. Legs: brown. Tibial spines: female 2221, male 0021. TmI: female 0.48-0.55, male 0.44-0.46. The metatarsi and tarsi of legs I of the male are less fusiform and have fewer hairs than in *S. vallicolens* (Fig. 33). Male palp: Figs. 29, 30, 32, 42. There is a distinct white excrescence, of rather variable size, on the joint between femur and patella: Crosby (1925) was mistaken in his statement, in his key, that the excrescence is absent in *S. spirotubus*. Female palp: tibia with three trichobothria (Fig. 38). Epigynum: Figs. 31, 36: the posterior plate is usually greyish white in color, and the spermathecae are indistinctly visible through the dark colored integument. The female genitalia, palpal organs and palpal tibiae of specimens taken at the limits of its known range (New Mexico and Canada) show no more than minimal variations.

Diagnosis.–This species falls into Section 7 in the Keys. The male of *S. spirotubus* is grouped with the closely related species *S. vallicolens*, *S. synopticus*, *S. proximus* and *S. montivagus* by the form of the palpal tibia coupled with the presence of the white excrescence between the palpal femur and patella. From *S. vallicolens* the male of *S. spirotubus* is distinguishable only by the small differences in the metatarsi and tarsi of legs I, which in *S. vallicolens* are more fusiform and have more numerous but shorter hairs (Fig. 33 cf. Fig. 34). *S. spirotubus* male is very close to *S. synopticus*, and the two species need to be separated with care. *S. spirotubus* has the embolic coil smaller in diameter and the suprategular apophysis rather shorter (Fig. 42 cf. Fig. 45); the palpal tibiae of the two species also show small differences (Fig. 30 cf. Fig. 31). The profile of the carapace/clypeus (Figs. 35, 37), used by Crosby (1925) to separate *S. spirotubus* and *S. synopticus*, shows some variation and should be used with caution in diagnosis. *S. spirotubus* male is distinguished from *S. proximus* by the presence in the latter of striated epigastric plates, and of a relatively much longer palpal patella (Fig. 29 cf. Fig. 48). The males of *S. spirotubus* and *S. montivagus* can be separated only by a small difference in the palpal tibiae (Fig. 30 cf. Fig. 43). In the female sex, *S. spirotubus* is grouped with *S. vallicolens*, *S. synopticus*, and *S. montivagus* by the epigynum, which is usually rather dark in color and obscure in pattern. The females of *S. spirotubus* and *S. vallicolens* cannot be separated by structural characters; the distribution of these two species appears on the whole to be different, however, and when further information has been obtained on distribution and/or habitat, females of the two species may perhaps be separable by ecological rather

than structural considerations. The epigyna of *S. spirotubus* and *S. synopticus* seem not to be distinguishable, and the internal genitalia are also very close; there is a small difference in the relative stoutness of the legs: e.g. tibia I l/d in *S. spirotubus* female is ca. 5, in *S. synopticus* ca. 6. *S. spirotubus* and *S. montivagus* are likewise indistinguishable by their epigyna, but there are small though distinct differences in the internal genitalia (Fig. 36 cf. Fig. 37). *S. montivagus* may also be distinguishable from *S. spirotubus* by its ecology, being probably a very high altitude species.



Figs. 29-38.—29, *S. spirotubus*, male palp, ectal; 30, *S. spirotubus*, male palpal tibia, dorsal; 31, *S. spirotubus*, epigynum; 32, *S. spirotubus*, male palp, mesal; 33, *S. spirotubus*, male metatarsus and tarsus, leg I, dorsal; 34, *S. vallicolens*, male metatarsus and tarsus, leg I, dorsal; 35, *S. spirotubus*, male carapace, lateral; 36, *S. spirotubus*, internal genitalia, ventral; 37, *S. synopticus*, male carapace, lateral; 38, *S. spirotubus*, female palpal tibia and tarsus, dorsal. Abbreviations: E, embolus; I, inferior tibial apophysis; P, paracymbium; SA, suprategular apophysis; TP, tailpiece (Scale lines 0.1 mm, except Figs. 35, 37, 0.2 mm).

Distribution.–This is the most widely distributed of the *Spirembolus* species, with records from New Mexico in the south to Canada in the north. There is only one record from Utah, but at this locality (Mt. Ellen, Henry Mts.: September 1929) *S. spirotubus* was sympatric with the closely related *S. vallicolens*. Because of the impossibility of distinguishing isolated females of *S. spirotubus* and *S. vallicolens*, only those localities where a male was taken are given in Map 1.

Natural History.–Adults of both sexes have been taken in practically every month of the year, but they seem to be most numerous in June-September. The species has been obtained by sweeping meadows (in Wyoming) and in pitfall traps in grassland and marshy ground in Alberta and Saskatchewan (Canada).

S. vallicolens (Chamberlin)
Figures 34, 46; Map 1

Cornicularia vallicolens Chamberlin 1920: 198.
Spirembolus vallicolens: Crosby 1925: 112; Roewer 1942: 666; Chamberlin and Ivie 1945: 220 (in part only); Bonnet 1958: 4123

Holotype.–Male holotype from Mill Creek Canyon, Utah, September 1929 (R. V. Chamberlin); in MCZ, examined.

Description.–In color, size and chaetotaxy this species is practically identical with *S. spirotubus*. The sex organs are also identical with those of *S. spirotubus*. The metatarsi and tarsi of legs I of the male are distinctly fusiform (Fig. 34), and fairly densely clothed with short hairs (cf. *S. spirotubus* Fig. 33); this small difference between the two species is clear and recognizable in preserved specimens.

S. vallicolens and *S. spirotubus* were confused by Chamberlin and Ivie (1945), and many of the vials in AMNH labelled "*S. vallicolens*" are in fact *S. spirotubus*. It is possible that *S. vallicolens* shoud be regarded as a sub-species of *S. spirotubus*; against this is the fact that the two species were sympatric in one locality (see *S. spirotubus*) and that no intermediates between the two forms have been seen.

Diagnosis.–*S. vallicolens* is very close to *S. spirotubus*, and its diagnosis is dealt with under that species.

Distribution.–Many of the records given by Chamberlin and Ivie (1945) refer to *S. spirotubus*. The majority of the true records are from Utah, with one from Idaho and one from California; the localities shown (Map 1) are limited to those where the male has been taken. In view of the apparently rather limited distribution, the California record (Palo Alto: J. C. Chamberlin, 1920-1921) needs confirmation.

Natural History.–Adults of both sexes have occurred throughout the year. There is no information on habitat.

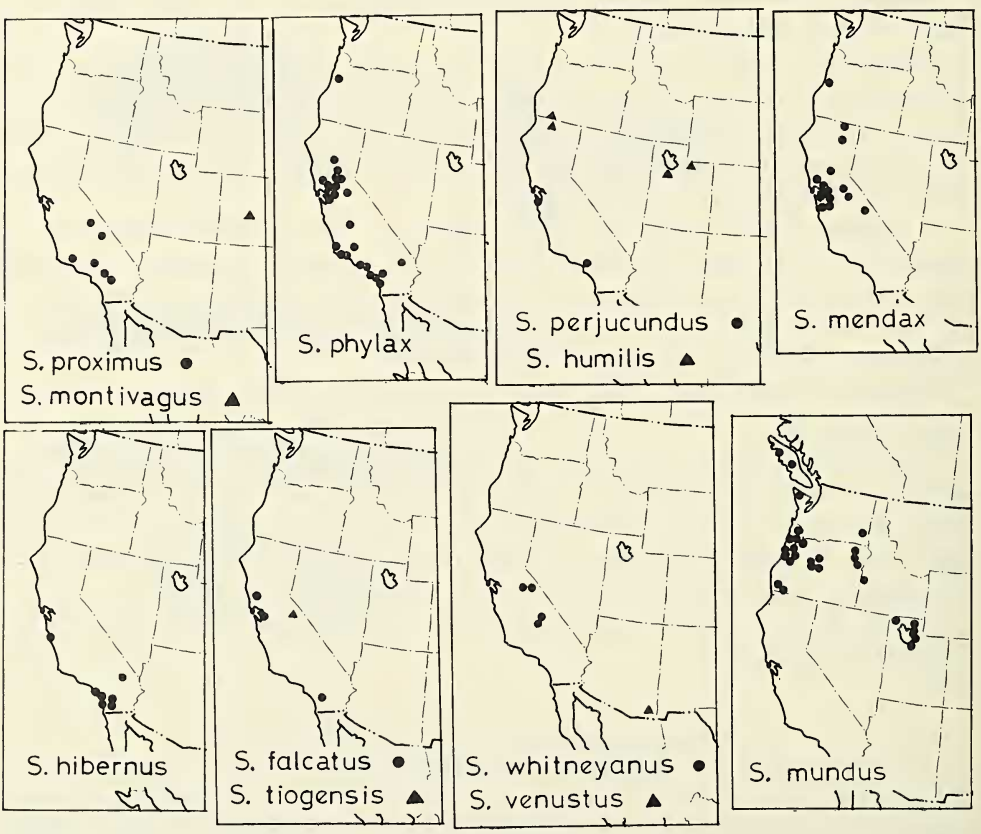
Spirembolus synopticus Crosby in Chamberlin 1925
Figures 37,39,40,41,45,49; Map 1

Spirembolus synopticus Crosby in Chamberlin 1925: 113; Roewer 1942: 666; Chamberlin and Ivie 1945: 219; Bonnet 1958: 4123

Holotype.–Male holotype from Berkeley, California, November 1919 (H. Dietrich); in MCZ, examine.

Description.—The female, described here for the first time, was not taken with the male, and its identity must be regarded as not completely certain; it agrees in most characters, however, with the male. Total length: female 2.1 mm, male 1.9-2.15 mm. Carapace: length: female 0.95 mm, male 0.90-1.0 mm. Deep brown, with blackish markings and margins. Male carapace only moderately raised, with clypeus fairly concave (Fig. 37). Abdomen: black. Sternum: deep brown, heavily suffused with black. Legs: yellow-brown to orange-brown. Tibial spines: female, spines missing, male 0021. TmI: female 0.51, male 0.50-0.55. Male palp: Figs. 41, 45, 49. There is a conspicuous white excrescence on the joint between femur and patella, particularly pronounced on the mesal side (Fig. 40). Female palp: tibia with 3 trichobothria. Epigynum: not distinguishable from that of *S. spirotubus*. Internal genitalia: Fig. 39.

Diagnosis.—*S. synopticus* is closely related to *S. spirotubus, S. vallicolens, S. proximus* and *S. montivagus*. Separation from *S. spirotubus/S. vallicolens* is dealt with under *S. spirotubus*. Females of *S. synopticus* and *S. proximus* can be distinguished by the epigyna; the males are separable by the greater length of the palpal patella in *S. proximus* (Fig. 49 cf. Fig. 48), by the presence in *S. proximus* in most cases of clear striae on the epigastric plates, and by the less steeply raised carapace of *S. synopticus* (Fig. 37 cf. Fig. 51). There are also small diffeerences in the stoutness of the legs, tibia I 1/d for *S.*

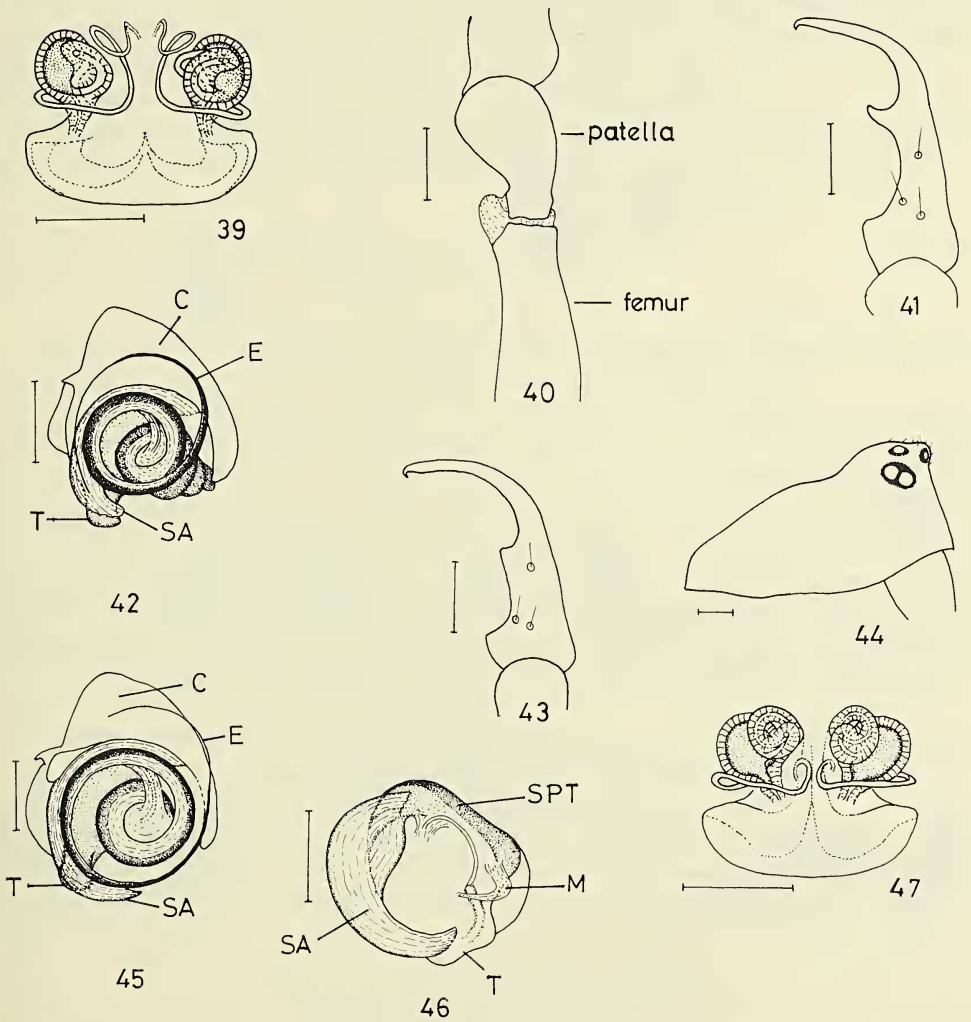


Map 2.—Western North America: distributions of *S. proximus, S. montivagus, S. phylax, S. perjucundus, S. humilis, S. mendax, S. hibernus, S. falcatus, S. tiogensis, S. whitneyanus, S. venustus* and *S. mundus*.

synopticus being 6 (female), 6-6.5 (male), and for *S. proximus* 7 (female), 8 (male). From *S. montivagus, S. synopticus* is separated in the male by the form of the palpal tibia (Fig. 41 cf. Fig. 43) and by the form of the carapace (Fig. 37 cf. Fig. 41). The females can be separated only by the internal genitalia (Fig. 39 cf. Fig. 47). *S. synopticus* is probably a low altitude species, while *S. montivagus* is a high mountain species.

Distribution.–Known only from a few localities in California (Map 1).

Natural History.–Males have been taken in autumn, November and December, and the possible female in December. The types were taken by sifting, and from branches of pine.

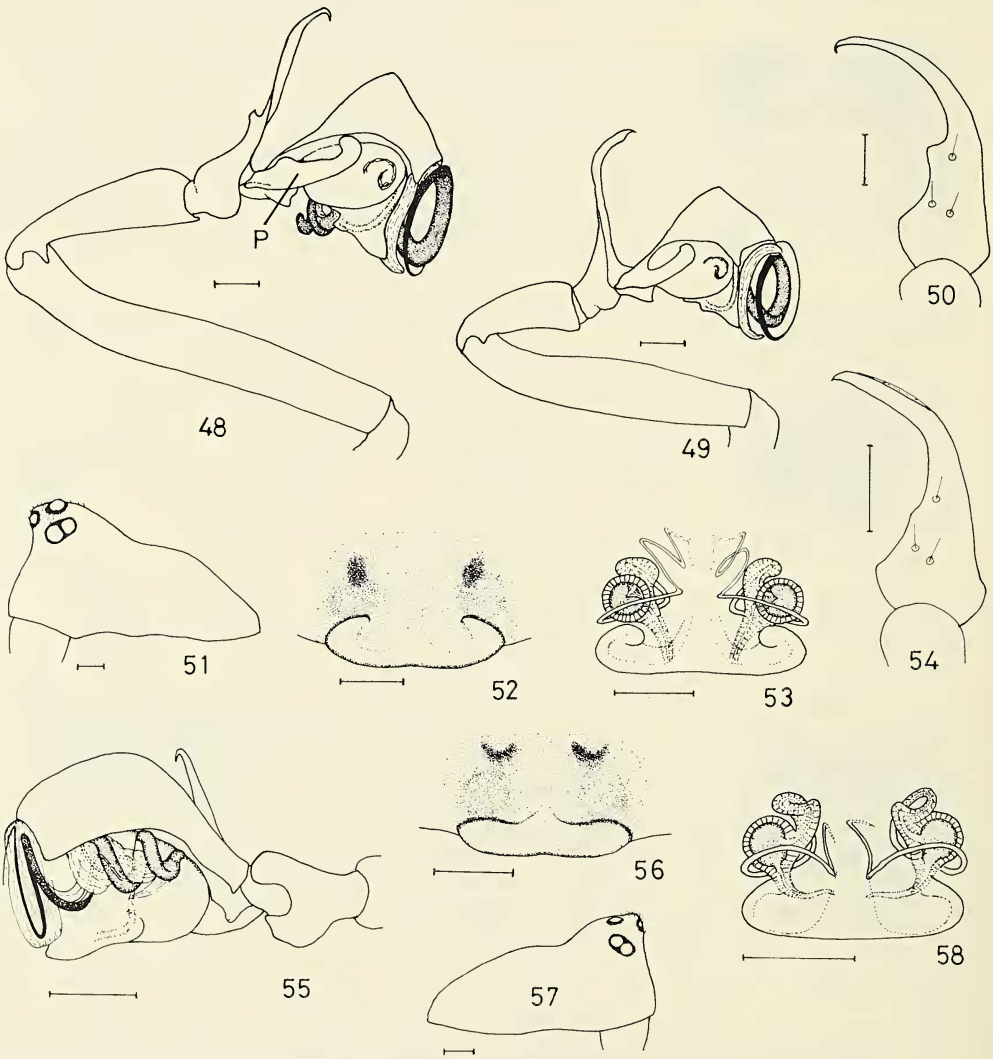


Figs. 39-47.–39, *S. synopticus*, internal genitalia, ventral; 40, *S. synopticus*, male palp, dorsal, showing excrescence between femur and patella; 41, *S. synopticus*, male palpal tibia, dorsal; 42, *S. spirotubus*, male palpal organ, from in front; 43, *S. montivagus*, male palpal tibia, dorsal; 44, *S. montivagus*, male carapace, lateral; 45, *S. synopticus*, male palpal organ, from in front; 46, *S. vallicolens*, male palpal organ, anterio-mesal, ED removed; 47, *S. montivagus*, internal genitalia, ventral. Abbreviations: C, cymbium; E, embolus; M, membraneous apophysis; SA, suprategular apophysis; SPT, suprategulum; T, tegulum (Scale lines 0.1 mm).

Spirembolus proximus, new species
Figures 48,50,51,52,53; Map 2

Holotype.–Male holotype from Mount Pinos, California, July 31, 1961 (Roth and Roth); deposited in AMNH.

Description.–The female described was not taken with the male, but from its characters it seems probable that it is of the same species. Total length: female 2.85-3.0 mm, male 2.1-2.15 mm. Carapace: length: female 1.2-1.25 mm, male 0.95 mm. Orange-brown to red-brown. Male carapace raised fairly sharply anteriorly (Fig. 51). Abdomen: grey to black. Epigastric plates of male with fairly closely spaced striae, sometimes



Figs. 48-58.–48, *S. proximus*, male palp, lateral; 49, *S. synopticus*, male palp, lateral; 50, *S. proximus*, male palpal tibia, dorsal; 51, *S. proximus*, male carapace, lateral; 52, *S. proximus*, epigynum; 53, *S. proximus*, internal genitalia, ventral; 54, *S. phylax*, male palpal tibia, dorsal; 55, *S. phylax*, male palp, mesal; 56, *S. phylax*, epigynum; 57, *S. phylax*, male carapace, lateral; 58, *S. phylax*, internal genitalia, ventral. Abbreviation: P, paracymbium (Scale lines 0.1 mm).

weakly developed; in the female the striae are closely spaced and very weak or absent. Sternum: orange-brown, suffused with black. Legs: orange-brown, rather long and thin. Tibial spines: female 2221, male 0021. TmI: female 0.45-0.50, male 0.46-0.51. Male palp: Figs. 48, 50; the femur and patella are relatively long. There is a small white excrescence between femur and patella. Female palp: tibia with 3 trichobothria. Epigynum: Figs. 52, 53. The epigynum and internal genitalia are similar to those of *S. mundus*, but the spermathecae are more widely spaced.

Diagnosis.–*S. proximus* is closely related to *S. spirotubus, S. vallicolens, S. synopticus* and *S. montivagus*. For distinctions from *S. spirotubus, S. vallicolens* and *S. synopticus*, refer to those species. The male of *S. proximus* has the palpal tibia very similar to that of *S. montivagus*, but the patella is much longer, *S. montivagus* being like *S. spirotubus* in this respect. The females of *S. proximus* and *S. montivagus* can be separated both by the epigyna and by the internal genitalia (Fig. 53 cf. Fig. 47).

Distribution.–Known from a few localities in California (Map 2).

Natural History.–Males have been taken in July, September and December, females in May and June. Nothing is recorded on habitat.

Spirembolus montivagus, new species
Figures 43, 44, 47; Map 2

Holotype.–Male holotype from North Pole Basin, Elk Mts. (12000 feet), Gunnison Co., Colorado, August 9, 1956 (H. and L. Levi); deposited in MCZ.

Description.–Total length: female 1.90-2.0 mm, male 1.80 mm. Carapace: length: female and male 0.80 mm. Brown with dusky markings and margins. Male carapace only very slightly raised (Fig. 44). Abdomen: grey to black. Sternum: brown, reticulated with black. Legs: brown. Tibial spines: female 2221, male 0021. TmI: female 0 45-0.50, male O.42. Male palp: this is identical with that of *S. spirotubus* in most respects, but there is a small difference in the tibia (Fig. 43, cf. Fig. 30). There is a small white excrescence between femur and patella. Female palp: tibia with 3 trichobothria. Epigynum: not distinguishable from that of *S. spirotubus*. The internal genitalia (Fig. 47), although of the same pattern as in *S. spirotubus*, show distinct differences which are well outside the range of variation of those of *S. spirotubus*.

Diagnosis.–This species is closely related to *S. spirotubus, S. vallicolens, S. synopticus* and *S. proximus*, and its diagnosis is dealt with under the diagnoses of those species.

Distribution.–Known only from the type locality (Map 2).

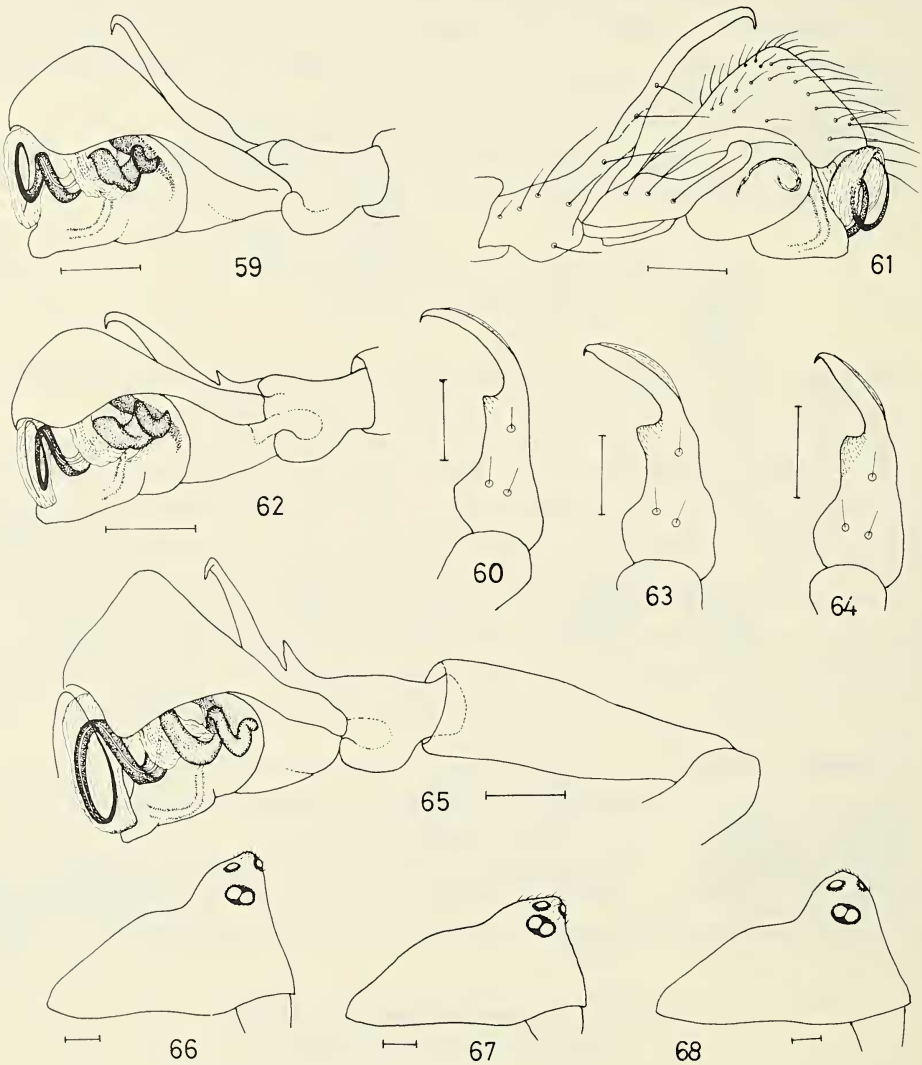
Natural History.–It is to be expected that this species will be found only at high altitudes. The specimens collected contained one adult and one sub-adult male, and several adult females; the chief maturity period is almost certainly in summer.

Spirembolus phylax Chamberlin and Ivie
Figures 54,55,56,57,58; Map 2

Spirembolus phylax Chamberlin and Ivie 1935: 19, 1945: 222; Roewer 1942: 666; Bonnet 1958: 4123

Holotype.–Male holotype from Laguna Beach, California, July 1931 (W. Ivie); in AMNH, examined.

Description.—The female, taken with the male, is described for the first time. Total length: female: 1.7-2.0 mm, male 1.6-1.9 mm. Carapace: length: female and male 0.8 mm. Orange-brown to dark brown, with dusky markings and margins. Male carapace raised sharply anteriorly (Fig. 57). Abdomen: grey to black. Epigastric plates with closely spaced striae in the male, usually absent or extremely weak in the female. Sternum: orange to brown, suffused with some black. Legs: orange-brown. Tibial spines: female 2221, male 0021. TmI: female 0.43-0.48, male 0.40-0.43. Male palp: Figs. 54, 55; the femur is long. The inferior tibial apophysis, the presence of which is characteristic of the



Figs. 59-68.—59, *S. perjucundus*, male palp, mesal; 60, *S. perjucundus*, male palpal tibia, dorsal; 61, *S. perjucundus*, male palp, ectal; 62, *S. humilis*, male palp, mesal; 63, *S. mendax*, male palpal tibia, dorsal; 64, *S. humilis*, male palpal tibia, dorsal; 65, *S. mendax*, male palp, mesal; 66, *S. perjucundus*, male carapace, lateral; 67, *S. humilis*, male carapace, lateral; 68, *S. mendax*, male carapace, lateral (Scale lines 0.1 mm).

spirotubus species group, is absent or vestigial in *S. phylax*. The embolic coil is of medium size. Female palp: tibia with 3 trichobothria. Epigynum: Figs. 56, 58.

Diagnosis.–This species falls into Sections 7 of the Keys. The male of *S. phylax* is distinguished from the others in the Section by the palpal tibia (Fig. 54) which lacks the inferior apophysis; confirmation is given by the form of the carapace (Fig. 57) and by the presence of the striae on the epigastric plates. Diagnosis of the female is based on the epigynum: the two crescent shaped markings are almost always clearly visible anterior to the spermathecae. The epigynum of *S. mendax* can be somewhat similar, but the internal ducts are normally much less visible in *S. phylax* than in *S. mendax* (Fig. 56 cf. Fig. 71, 72); the epigyna of these two species are somewhat variable, however, and the internal genitalia offer a more reliable means of separation (Fig. 58 cf. Fig. 75). The epigynum of *S. phylax* is also quite similar to, but usually distinguishable from, that of *S. falcatus* (Fig. 88); the females of these two species also differ in size (*S. phylax* being larger) and in the stoutness of the legs: metatarsus I 1/d and tibia I 1/d being 8.5-9 and 5.5-6 respectively for *S. phylax* and 7 and 4-4.5 for *S. falcatus*.

Distribution.–Most of the records are from California, with one from Oregon (Map 2).

Natural History.–Both sexes have been taken in practically every month of the year. Nothing is recorded on habitat.

Spirembolus perjucundus Crosby in Chamberlin 1925
Figures 59,60,61,66,69,73; Map 2

Spirembolus perjucundus Crosby in Chamberlin 1925: 114; Roewer 1942: 666; Bonnet 1958: 4123. *Not S. perjucundus* Chamberlin and Ivie 1945: Figs. 28-31.

Types.–Male holotype from San Gregorio Beach, San Mateo Co., California, 1920-1921 (J. C. Chamberlin); in MCZ, examined. The male paratype mentioned by Crosby in the same paper, from Berkeley, California, is *S. elevatus*.

Description.–The female, taken in company with the male, is described for the first time. Total length: female 1.55-1.75 mm, male 1.55-1.60 mm. Carapace: length: female and male 0.70-0.75 mm. Brown to deep brown, with dusky margins. Male carapace sharply raised anteriorly (Fig. 66). Abdomen: grey-black. Sternum: brown, reticulated with black. Legs: brown. Tibial spines: female 2221, male 0021. TmI: female 0.40-0.42, male 0.40. Male palp: Figs. 59, 60, 61. The femur and patella are long; the embolus forms a small coil anteriorly. Female palp: tibia with 3 trichobothria. Epigynum: Figs. 69, 73.

Diagnosis.–The male of *S. perjucundus* is separated from other species in Section 7 of the key, and grouped with *S. mendax*, by the steeply raised carapace (Fig. 66); from *S. mendax*, *S. perjucundus* is readily distinguished by the smaller size of the embolic coil (Fig. 59 cf. Fig. 65). *S. perjucundus* male is very close to *S. humilis*, the chief difference being in the lower anterior elevation of the carapace (Fig. 66 cf. Fig. 67); there are other very small differences: the embolic coil is slightly smaller anteriorly, the SA is slightly shorter and the palpal patella is relatively shorter. The female of *S. perjucundus* is diagnosed by the epigynum, but this is indistinguishable from that of *S. humilis*; the internal genitalia of these two species are also very close and only doubtfully distinguishable. The epigynum of *S. hibernus* is also very similar to that of *S. perjucundus*, but usually distinguishable (Fig. 69 cf. Figs. 79, 82). An additional small difference from *S. hibernus* female lies in the somewhat stouter legs of *S. perjucundus*, where e.g. metatarsus I 1/d is 6-6.5, tibia I 1/d is 4.5, cf. figures of 7.5-8 and 5.5 for *S. hibernus*.

Distribution.—Known only from two localities in California (Map 2).

Natural History.—Males have been taken in April and September, females in September. The only information on habitat is that the holotype was taken on a beach.

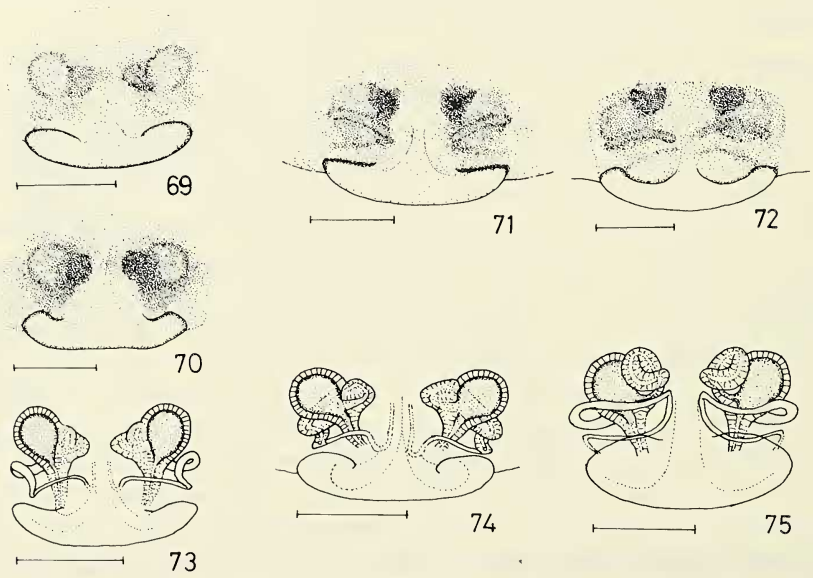
Spirembolus humilis, new species
Figures 62,64,67,70,74,84; Map 2

Spirembolus perjucundus: Chamberlin and Ivie 1945: 221; not *S. perjucundus* Crosby

Holotype.—Male holotype from Mirror Lake, Uintah Mts., Utah, July 28, 1936 (W. Ivie); deposited in AMNH.

Description.—Total length: female 1.65-1.75 mm, male 1.55 mm. Carapace: length: female 0.80 mm, male 0.70-0.75 mm. Brown to deep-brown, with dusky markings and margins. Male carapace moderately raised (Fig. 67), with usually a tiny hump in the ocular area. Abdomen: grey to black. Sternum: deep brown, suffused with black. Legs: brown. Tibial spines: female 2221, male 0011 or 0021. TmI: female 0.42-0.48, male 0.41-0.45. Male palp: Figs. 62, 64; the palpal organ is barely distinguishable from that of *S. perjucundus*. The femur and patella are long. Female palp: tibia with 3 trichobothria. Epigynum: Fig. 70; this is rather obscure in color and not very distinctive. Internal genitalia: Fig. 74.

Diagnosis.—*S. humilis* is very close to *S. perjucundus*, of which it should possibly be regarded as a sub-species. In the male, the principal difference from *S. perjucundus* lies in the lower anterior elevation of the carapace (Fig. 67 cf. Fig. 66). The females of *S. humilis* and *S. perjucundus* are barely if at all distinguishable (see also *S. perjucundus* diagnosis).



Figs. 69-75.—69, *S. perjucundus*, epigynum; 70, *S. humilis*, epigynum; 71, *S. mendax*, epigynum; 72, *S. mendax*, epigynum, another specimen; 73, *S. perjucundus*, internal genitalia, ventral; 74, *S. humilis*, internal genitalia, ventral; 75, *S. mendax*, internal genitalia, ventral (Scale lines 0.1 mm).

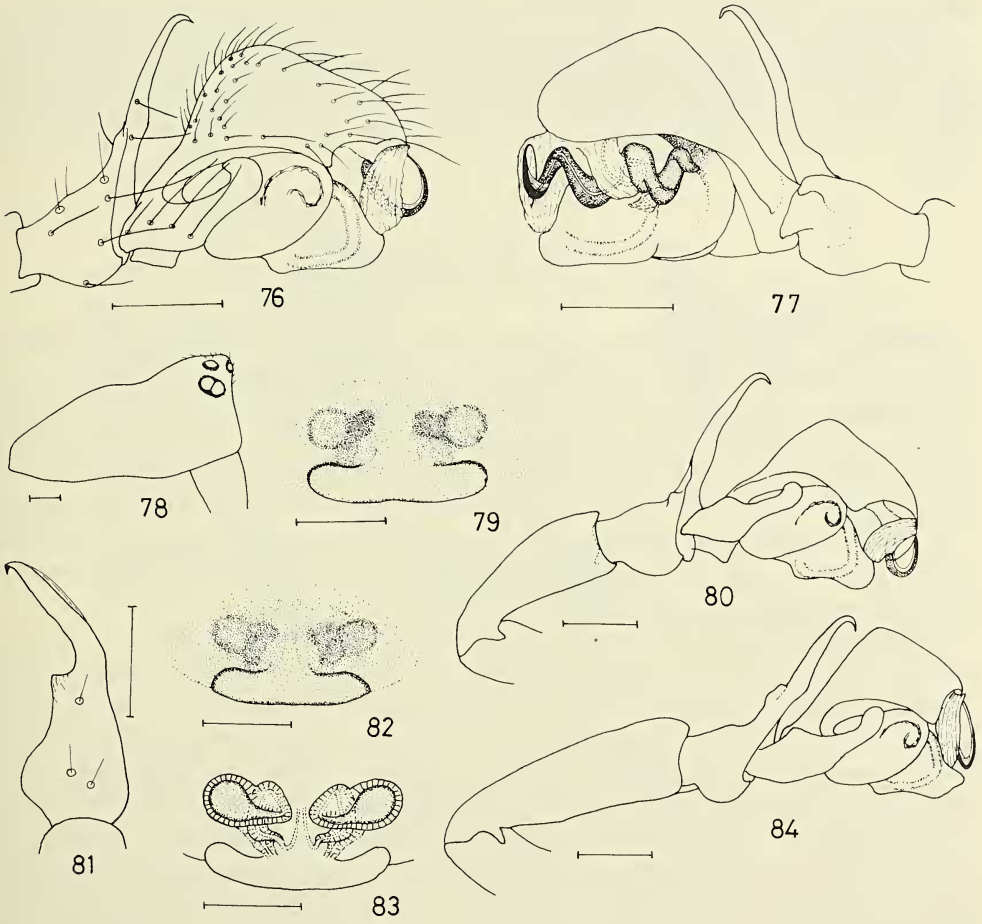
Distribution.–Known only from Utah, Oregon and northern California (Map 2).

Natural History.–Males have been taken in July and September, females in April, July and September; the main period of maturity is probably in summer. The only habitat recorded is in lombardy poplar debris in Tooele Co., Utah, at 1300 m altitude in May.

Spirembolus mendax, new species
Figures 63, 65, 68, 71, 72, 75; Map 2

Holotype.–Male holotype from Alum Rock Park, near San Jose, California, December 15, 1953 (D. Burdick); deposited in AMNH.

Description.–Total length: female 1.9-2.1 mm, male 1.7-1.8 mm. Carapace: length: female 0.90-0.95 mm, male 0.85 mm. Orange-brown to deep brown with dusky margins. Male carapace sharply and steeply elevated (Fig. 68). Abdomen: grey to black. Sternum: orange-brown, suffused with black. Legs: brown. Tibial spines: female 2221, male 0121.



Figs. 76-84.–76, *S. hibernus*, male palp, ectal; 77, *S. hibernus*, male palp, mesal; 78, *S. hibernus*, male carapace, lateral; 79, *S. hibernus*, epigynum; 80, *S. hibernus*, male palp, ectal; 81, *S. hibernus*, male palpal tibia, dorsal; 82, *S. hibernus*, epigynum, another specimen; 83, *S. hibernus*, internal genitalia, ventral; 84, *S. humilis*, male palp, ectal (Scale lines 0.1 mm).

Tml: female 0.41-0.46, male 0.37-0.40. Male palp: Figs. 63, 65; the embolus forms a coil of moderately large diameter. Female palp: tibia with 3 trichobothria. Epigynum: Figs. 71, 72, 75.

Diagnosis.—*S. mendax* falls into Sections 7 of the Keys. The male is separated from the others in this section, and grouped with *S. perjucundus*, by the steeply raised carapace; *S. mendax* is then readily distinguished by the larger size of the embolic coil (Fig. 65 cf. Fig. 59). In the AMNH Collection, *S. mendax* male was in several instances mistaken for *S. perjucundus*. Diagnosis of the female is based on the genitalia. The epigynum can be rather similar to that of *S. phylax* (q.v.), but usually the anterior crescent-shaped markings are less clear and the more robust internal ducts show moderately clearly through the integument in *S. mendax* (Figs. 71, 72 cf. Fig. 56). *S. mendax* has stouter sperm ducts than in *S. phylax* (Fig. 75 cf. Fig 58); the duct configuration bears a similar relationship to that of *S. perjucundus* as shown by the species pair *S. monticolens/S. pachygnathus*. *S. mendax* can usually be separated fairly readily from *S. falcatus* by the epigynum (Figs. 71, 72 cf. Fig. 88), coupled with the somewhat more slender legs of *S. mendax*, which has the same 1/d ratios as in *S. phylax* (q.v.).

Distribution.—Most of the records are from California, with one from Oregon (Map 2).

Natural History.—Males have been taken in December, January, February, March and May, females in December, February, April, May, June, July and September. The main period of maturity seems probably to be in the winter months. Nothing is recorded on habitat.

Spirembolus hibernus, new species
Figures 76,77,78,79,80,81,82,83; Map 2

Holotype.—Male holotype from Cleveland National Forest, 5 miles west of Henshaw Lake, California, February 16, 1958 (I. Newell); deposited in AMNH.

Description.—Total length: female 2.0-2.1 mm, male 1.6 mm. Carapace: length: female 0.80-0.85 mm, male 0.75 mm. Orange-brown with faint dusky markings. Male carapace only moderately raised (Fig. 78). Abdomen: grey to black. Sternum: yellow-brown with dusky margins. Legs: orange brown. Tibial spines: female 2221, male 0021. Tml: female 0.37-0.40, male 0.35. Male palp: Figs. 76, 77, 80, 81; the embolus forms a small coil. The patella is shorter than in *S. humilis* (Fig. 80 cf. Fig. 84). Female palp: tibia with 3 trichobothria. Epigynum: Figs. 79, 82, 83.

Diagnosis.—This species falls into Sections 7 of the Keys. In the male sex, *S. hibernus* has the palpal tibia of the same general form as in *S. perjucundus, S. humilis* and *S. mendax*. From *S. perjucundus* it is at once separated by the lower elevation of the carapace (Fig. 78 cf. Fig. 66), and from *S. mendax* by the much smaller diameter of the embolic coil (Fig. 77 cf. Fig. 65). From *S. humilis* the male is distinguished by the relatively shorter palpal patella and by a small difference in the SA (Fig. 80 cf. Fig. 84). In the female sex, the epigynum is similar to those of *S. perjucundus* and *S. humilis*, but normally seems to be distinguishable (Figs. 79, 82, cf. Figs. 69, 70); the internal genitalia also show small differences (Fig. 83 cf. Figs. 73, 74). *S. hibernus* female also has rather more slender legs than those of *S. perjucundus* and *S. humilis*: for *S. hibernus* tibia I 1/d is 5.5, metatarsus I 1/d is 7.5-8, cf. corresponding figures of 4.5 and 6-6.5 for *S. perjucundus* and *S. humilis*.

Distribution.—The species is recorded from a number of localities in California (Map 2).

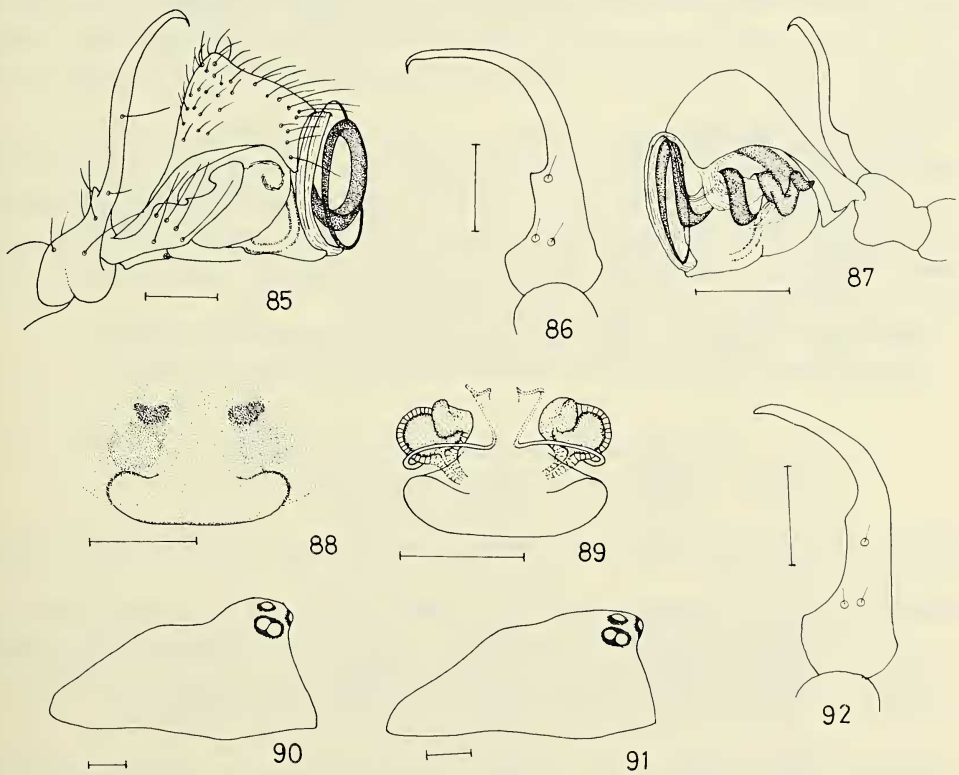
Natural History.–Males have been taken in February, April and October, females in February, March, April, July, August and October; it seems probable that the main period of maturity is during the winter months. There is no information on habitat.

Spirembolus falcatus, new species
Figures 85,86,88,89,90; Map 2

Holotype.–Male holotype from San Jacinto Mts., California, October 29, 1955 (I. Newell); deposited in AMNH.

Description.–Total length: female 1.65-1.70 mm, male 1.60-1.65 mm. Carapace: length: female and male 0.70-0.75 mm. Yellow-brown to chestnut brown, with dusky markings and margins. Male carapace fairly sharply elevated (Fig. 90). Abdomen: grey to black. Sternum: yellow to brown, suffused with black. Legs: pale brown to brown. Tibial spines: female 2221, male 0011. Tml: female 0.46-0.55, male 0.50-0.55. Male palp: Figs. 85, 86. Female palp: tibia with 3 trichobothria. Epigynum: Figs. 88, 89.

Diagnosis.–This species falls into Sections 7 of the Keys. The male is diagnosed by the palpal tibia, which is of the same general form as that of *S. spirotubus* and related species, but with different proportions; in addition, the white excrescence present between femur and patella in *S. spirotubus*, etc. is absent in *S. falcatus*. The male of *S. falcatus* is very



Figs. 85-92.–85, *S. falcatus*, male palp, ectal; 86, *S. falcatus*, male palpal tibia, dorsal; 87, *S. tiogensis*, male palp, mesal; 88, *S. falcatus*, epigynum; 89, *S. falcatus*, internal genitalia, ventral; 90, *S. falcatus*, male carapace, lateral; 91, *S. tiogensis*, male carapace, lateral; 92, *S. tiogensis*, male palpal tibia, dorsal (Scale lines 0.1 mm).

similar to *S. tiogensis* and *S. montivagus*, but these species show small differences in the palpal tibiae; in addition, the carapace forms distinguish *S. falcatus* and *S. tiogensis*, while *S. montivagus* is distinguished by the presence of the white excrescence between palpal femur and patella. The female of *S. falcatus* is diagnosed by the epigynum, which is rather similar to that of *S. phylax* though normally distinguishable (Fig. 88 cf. Fig. 56); the internal genitalia are probably too similar to be of value in diagnosis. The female of *S. falcatus* is most frequently smaller than *S. phylax*, and the legs are slightly stouter (see *S. phylax* diagnosis).

Distribution.—Known only from a few localities in California (Map 2).

Natural History.—Males have been taken in October, December and January, females in October and December; hence the chief period of maturity is probably in winter. There is no information on habitat.

Spirembolus tiogensis, new species
Figures 87, 91, 92; Map 2

Holotype.—Male holotype from Tioga Pass, 10,000 ft., California, September 22, 1961 (W. J. Gertsch and W. Ivie); deposited in AMNH.

Description.—Only the male is known. Total length: male 1.45 mm. Carapace: length: male 0.65 mm. Brown, with dusky markings and margins; barely raised anteriorly (Fig. 91). Abdomen: grey-black. Sternum: brown, suffused with black. Legs: brown. Tibial spines: male 0021. TmI: male 0.48. Male palp: Figs. 87, 92; the inferior apophysis on the tibia is very small.

Diagnosis.—*S. tiogensis* falls into Section 7 of the Key. It is close to *S. falcatus*, from which it is distinguished by small differences in the palpal tibia (Fig. 92 cf. Fig. 86) and in the carapace (Fig. 91 cf. Fig. 90); the embolic coil is somewhat smaller in diameter anteriorly than in *S. falcatus*. *S. tiogensis* male is also similar to *S. montivagus*: there is a small difference in the palpal tibia, and the palp of *S. montivagus* has a white excrescence between femur and patella which is lacking in *S. tiogensis*.

Distribution.—Known only from the type locality (altitude 3280 m) (Map 2).

Natural History.—Presumably this species is limited to the high mountains.

Spirembolus whitneyanus Chamberlin and Ivie
Figures 93, 94, 95, 96, 97; Map 2

Spirembolus whitneyanus Chamberlin and Ivie 1935: 20, 1945: 222; Roewer 1942: 666; Bonnet 1958: 4123

Spirembolus orthus Chamberlin 1948: 548. NEW SYNONYMY. Chamberlin does not appear to have designated a type of *S. orthus*, but there is one vial in the AMNH material which has the locality label and other data agreeing completely with the data given by Chamberlin: this contains a single female which is *S. whitneyanus*.

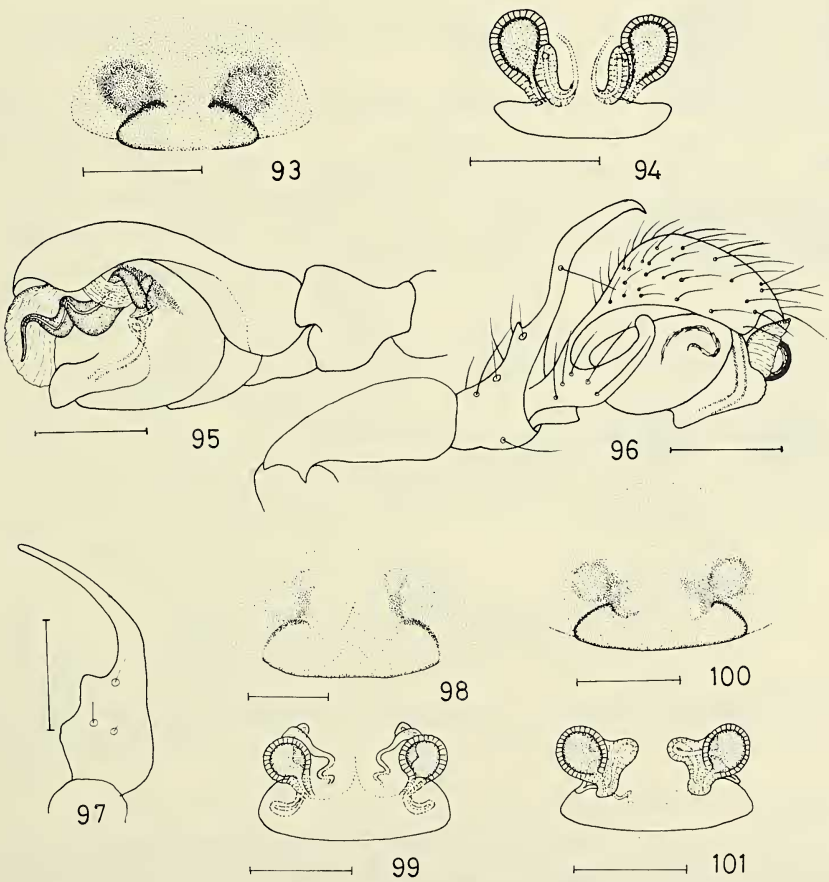
Holotype.—Male holotype, Mt. Whitney, California, August 8, 1931 (W. Ivie); in AMNH, examined.

Description.—Total length: female 1.40-1.60 mm, male 1.30-1.40 mm. Carapace: length: female: 0.70 mm, male 0.65 mm. Brown, with dusky markings and margins. Male carapace only slightly raised. Abdomen: grey. Sternum: brown, with dusky margins.

Legs: brown. Tibial spines: female 2221, male 0021 or 1121. TmI: female 0.42-0.46, male 0.40-0.44. The short curved hairs on the male tibiae and metatarsi I and II are more weakly developed than in the other members of the *spirotubus* species group. Male palp: Figs. 95, 96, 97; embolus short and rather stout, in a coil of small diameter. Female palp: tibia with 3 trichobothria. Epigynum: Figs. 93, 94.

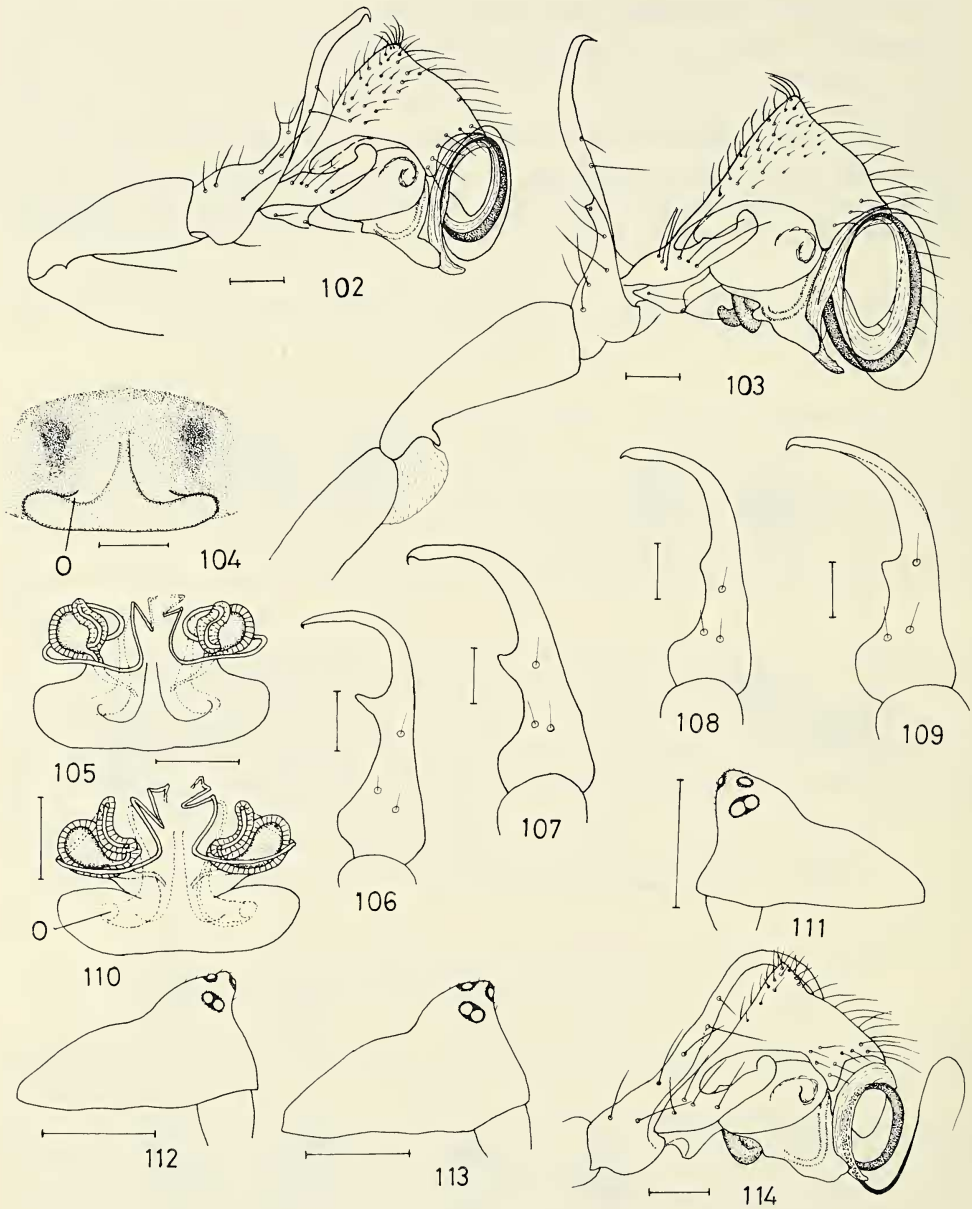
Diagnosis.–In the male, the relatively small size, the short stout embolus (Fig. 95) and the small elevation of the carapace suffice to distinguish *S. whitneyanus* from all other species falling in Section 7 of the Key. In the female, the epigynum differs sufficiently from those species grouped in Section 7 of the Key to make diagnosis fairly easy. The species most likely to be confused with *S. whitneyanus* female is *S. redondo*, but the differences are usually distinct enough (Fig. 93 cf. Fig. 186). In addition, *S. whitneyanus* female has somewhat stouter legs (e.g. tibia I 1/d is 4-4.5) than *S. redondo* (tibia I 1/D ca. 6).

Distribution.–This species has been taken on very few occasions, from a few localities in California (Map 2).



Figs. 93-101.–93, *S. whitneyanus*, epigynum; 94, *S. whitneyanus*, internal genitalia, ventral; 95, *S. whitneyanus*, male palp, meso-ventral; 96, *S. whitneyanus*, male palp, ectal; 97, *S. whitneyanus*, male palpal tibia, dorsal; 98, *S. venustus*, epigynum; 99, *S. venustus*, epigynum, cleared; 100, *S. chilkatensis*, epigynum; 101, *S. chilkatensis*, internal genitalia, ventral (Scale lines 0.1 mm).

Natural History.—Adults of both sexes have been taken in August and September; the chief period of maturity may therefore be in summer. The only habitat mentioned is under stones near water, at Mono Lake, California.



Figs. 102-114.—102, *S. mundus*, male palp, ectal; 103, *S. latebricola*, male palp, ectal; 104, *S. mundus*, epigynum; 105, *S. mundus*, internal genitalia, ventral; 106, *S. elevatus*, male palpal tibia, dorsal; 107, *S. mundus*, male palpal tibia, dorsal; 108, *S. mundus*, male palpal tibia, dorsal (another specimen); 109, *S. latebricola*, male palpal tibia, dorsal; 110, *S. mundus*, internal genitalia, ventral (another specimen); 111, *S. elevatus*, male carapace, lateral; 112, *S. mundus*, male carapace, lateral; 113, *S. latebricola*, male carapace, lateral; 114, *S. elevatus*, male palp, ectal. Abbreviation: O, probable position of opening to spermathecal duct (Scale lines 0.1 mm, except Figs. 111, 112, 113, 0.5 mm).

Spirembolus venustus, new species
Figures 98, 99; Map 2

Holotype.–Female holotype from Sabino Canyon, near Tucson, Arizona, June 5, 1952 (W. J. Gertsch, M. Cazier and R. Schrammel); deposited in AMNH.

Description.–Only the female is known. Total length: female 2.0 mm. Carapace: length: female 0.90 mm. Pale orange. Abdomen: grey. Sternum: yellow. Legs: orange-brown. Tibial spines: female 2221. TmI; female 0.40. Female palp: tibia with 3 trichobothria. Epigynum: Figs. 98, 99.

Diagnosis.–The epigynum, coupled with the rather attractive color, distinguish this species from all others falling in Section 7 of the Key.

Distribution.–Known only by the holotype (Map 2).

Natural History.–Nothing known.

Spirembolus chilkatensis (Chamberlin and Ivie), new combination
Figures 100, 101; Map 4

"*Erigone*" *chilkatensis* Chamberlin and Ivie 1947: 38

Holotype.–Female holotype from Haines, Alaska, August 20-25, 1945 (J. C. Chamberlin); in AMNH, examined.

Description.–Only the female is known. Total length: female 1.9-2.3 mm. Carapace: length: female 0.8-1.0 mm. Orange-brown, with dusky markings and margins. Abdomen: grey. Epigastric plates with closely spaced striae. Sternum: yellow, with dusky margins. Legs: brown. Tibial spines: female 2221. TmI: female 0.50-0.55. Female palp: tibia with 3 trichobothria. Epigynum: Figs. 100, 101.

Diagnosis.–This species falls in Section 7 of the Key. The presence of striae on the epigastric plates, coupled with the form of the epigynum are sufficient to distinguish this species from all others in Section 7.

Distribution.–This species is known from two localities near the north-west coast: Alaska (the type) and Oregon (two paratype females) (Map 4).

Natural History.–The females were taken in August and November. Nothing is known on habitat.

Spirembolus mundus Chamberlin and Ivie
Figures 102,104,105,107,108,110,112; Map 2

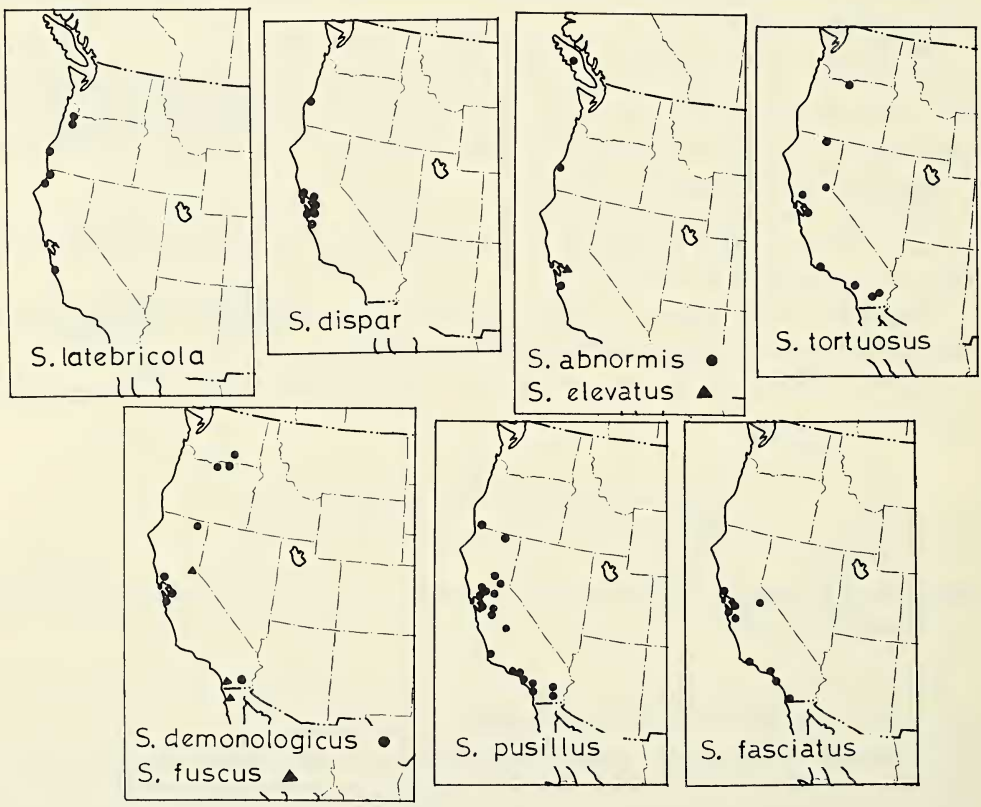
Spirembolus mundus Chamberlin and Ivie 1933: 18, 1945: 218; Roewer 1942: 666; Bonnet 1958: 4122.

Holotype.–Male holotype from Clear Creek, Raft River Mts., Utah, September 4, 1932 (R. V. Chamberlin and W. Ivie); in AMNH, examined.

Description.–Total length: female 2.8-3.0 mm, male 2.40-2.60 mm. Carapace: length: female 1.15-1.30 mm, male 1.05-1.10 mm. Reddish brown or orange, with dusky markings and margins. Male carapace moderately steeply raised (Fig. 112). Abdomen: shiny black. Sternum: brown, suffused with black particularly on margins. Legs: orange-brown to yellow-brown. Tibial spines: female 2221, male 0021. TmI: female and male

0.60-0.68. Male palp: Figs. 102, 107, 108; the cymbium is raised almost to a point, and the embolus forms a fairly wide coil. There is a small white excrescence between femur and patella. The size of the inferior apophysis on the tibia is somewhat variable. Female palp: tibia with 3 trichobothria. Epigynum: Fig. 104. Internal genitalia: Figs. 105, 110; the appearance is somewhat variable depending on the angle taken up by the spermathecae.

Diagnosis.—The high value of TmI places this species in Section 5 of the Keys. The males of *S. mundus* and *S. latebricola* are separated easily from *S. elevatus*, *S. dispar* and *S. abnormis* by a combination of the larger size, the brighter color of the carapace and legs, the form of the carapace (Figs. 112, 113 cf. Figs 111, 118, 124) and the form of the palpal tibia (Figs. 107, 109 cf. Figs. 106, 122, 125). *S. mundus* male is distinguished from *S. latebricola* by the somewhat smaller diameter of the embolic coil and the slightly shorter palpal patella (Fig. 102 cf. Fig. 103). The female of *S. mundus* is separated from *S. dispar* and *S. abnormis* by the size, color and the epigynum (Fig. 104 cf. Figs. 117, 120). Females of *S. mundus* and *S. latebricola* seem not to be distinguishable. In the Museum material, there were several instances where the female of *Coreorgonal monoceros* (Simon) had been mistaken for *S. mundus*; although the females of these two species are very similar in general appearance, e.g. in size, color and value of TmI, the epigyna are in fact readily distinguishable. The genus *Coreorgonal* will be dealt with in a following paper.



Map 3.—Western North America: distributions of *S. latebricola*, *S. dispar*, *S. abnormis*, *S. elevatus*, *S. tortuosus*, *S. demonologicus*, *S. fuscus*, *S. pusillus* and *S. fasciatus*.

Distribution.–The species has been recorded from Utah, Idaho, Oregon, Washington and British Columbia (Map 2).

Natural History.–Males and females have been taken in all months except February, July and August. The habitats recorded are: amongst dead leaves (in April and September, Utah), on grapes (in September, Oregon), inside a house (in November, Oregon) and aeronauting (in November, Oregon).

Spirembolus latebricola, new species
Figures 103, 109, 113; Map 3

Holotype.–Male holotype from Patrick Point State Park, California, September 21, 1964 (J. and W. Ivie); deposited in AMNH.

Description.–Total length: female 2.6-3.1 mm, male 2.7-2.9 mm. Carapace: length: female 1.10-1.30 mm, male 1.10-1.20 mm. Brown to orange-brown, with dusky markings and margins. Although there is always some variation, the male carapace (Fig. 113) is normally somewhat more steeply raised than that of *S. mundus*. Abdomen: shiny black. Sternum: orange-brown, suffused with black. Legs: orange-brown. Tibial spines: female 2221, male 0021. TmI: female 0.62-0.65, male 0.60-0.62. Male palp: Figs. 103, 109; very similar to *S. mundus*, but the embolic coil is larger in diameter. There is a white excrescence, sometimes quite large, between femur and patella. Female palp: tibia with 3 trichobothria. Female genitalia: not distinguishable from those of *S. mundus*.

Diagnosis.–This is dealt with under the diagnosis of *S. mundus*.

Distribution.–This species is known from a few localities in California and Oregon (Map 3).

Natural History.–Both sexes were taken in September and October; nothing was recorded on habitat.

Spirembolus elevatus, new species
Figures 106, 111, 114; Map 3

Holotype.–Male holotype from Berkeley, California, November 1919 (H. Dietrich); deposited in AMNH. This specimen was labelled by Crosby "*Spirembolus perjucundus*. Paratype".

Description.–Only the male is known. Total length: male 1.65 mm. Carapace: length: male 0.85 mm. Steeply raised anteriorly (Fig. 111). Abdomen: grey-black. Sternum: yellow, suffused with grey. Legs: pale yellow. Tibial spines: male 0021. TmI: male 0.67. Male palp: Figs. 106, 114; the cymbium is raised almost to a point, as in *S. mundus*. There is a small excrescence between femur and patella. The specimen is practically 60 years old, and it is probable that new specimens will be more deeply colored.

Diagnosis.–The high value of TmI places this species in Section 5 of the Key with *S. mundus, S. latebricola, S. dispar* and *S. abnormis*. *S. elevatus* is distinguished from these four species by a combination of the form of the carapace (Fig. 111) and of the palpal tibia (Fig. 106). The palpal tibia is of the same general pattern as those of *S. mundus* and *S. latebricola*, but size alone will prevent any confusion with these two species.

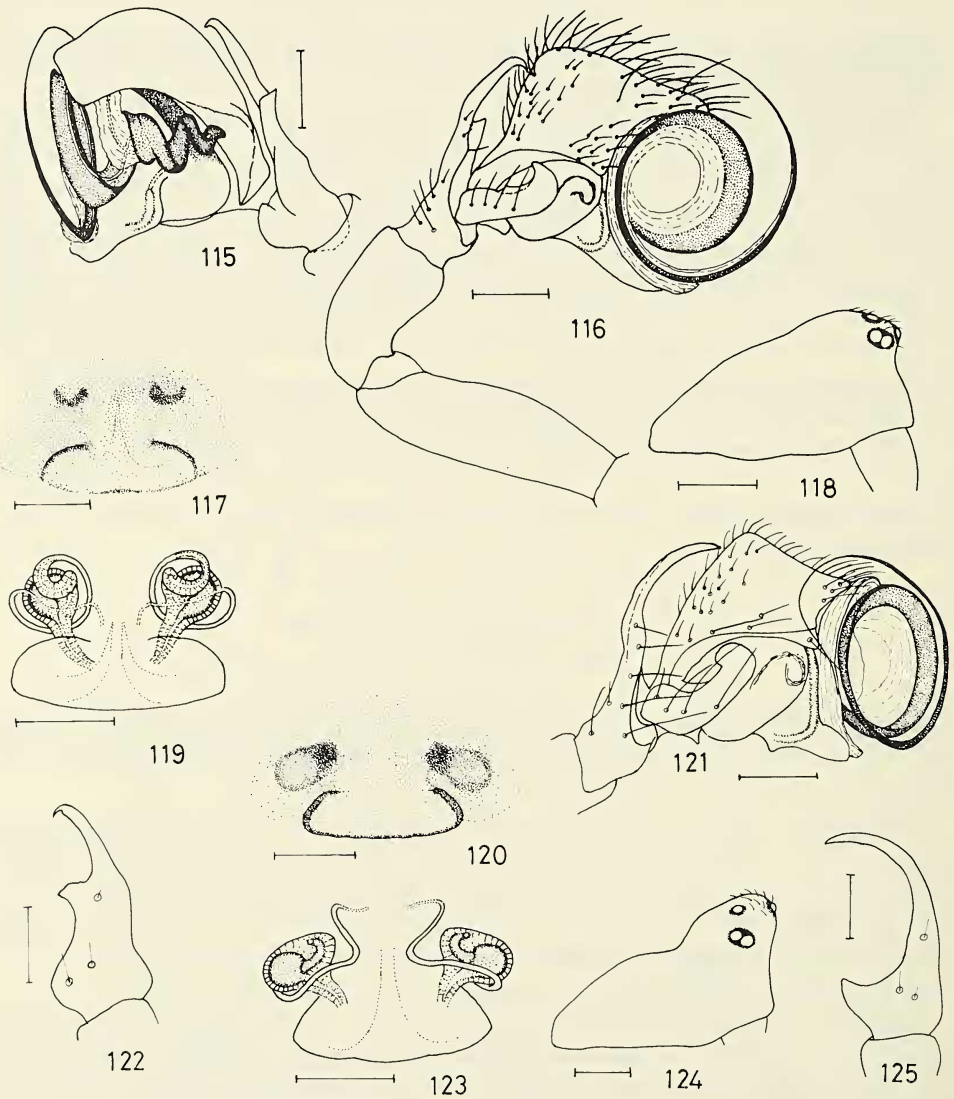
Distribution.–Known only from the holotype (Map 3).

Natural History.–There is no information on habitat.

Spirembolus dispar, new species
Figures 115,116,117,118,119,122; Map 3

Holotype.—Male holotype from Pebble Beach, California, March 25, 1957 (A. M. Nadler); deposited in AMNH.

Description.—Total length: female 1.9-2.1 mm, male 1.7 mm. Carapace: length: female 0.80-0.85 mm, male 0.75-0.80 mm. Brown, with dusky markings and margins. Male carapace not greatly raised (Fig. 118). Abdomen: black. Sternum: brown, suffused with



Figs. 115-125.—115, *S. dispar*, male palp, mesal; 116, *S. dispar*, male palp, ectal; 117, *S. dispar*, epigynum; 118, *S. dispar*, male carapace, lateral; 119, *S. dispar*, internal genitalia, ventral; 120, *S. abnormis*, epigynum; 121, *S. abnormis*, male palp, ectal; 122, *S. dispar*, male palpal tibia, dorsal; 123, *S. abnormis*, internal genitalia, ventral; 124, *S. abnormis*, male carapace, lateral; 125, *S. abnormis*, male palpal tibia, dorsal (Scale lines 0.1 mm, except Figs. 118, 124, 0.2 mm).

black. Legs: brown to pale brown. Tibial spines: female 2221, male 0021. TmI: female and male 0.75-0.80. Male palp: Figs. 115, 116, 122; the embolus forms a wide coil anteriorly. Female palp: tibia with 3 trichobothria. Epigynum: Figs. 117, 119.

Diagnosis.–The high value of TmI places this species in Section 5 of the Keys. The male of *S. dispar* is separated clearly from the other members of this group by a combination of the form of the palpal tibia (Fig. 122 cf. Figs. 106, 107, 109, 125) and of the carapace (Fig. 118 cf. Figs. 111, 112, 113, 124). The female is readily distinguished from the others in the group by the epigynum (Fig. 117 cf. Figs. 104, 120). *S. dispar* is smaller and less striking in color than *S. mundus* and *S. latebricola*, and has a higher value of TmI.

Distribution.–Recorded from California and Oregon only (Map 3).

Natural History .–Both sexes were taken in January, March, April and September; most specimens were taken in January/March. Nothing is known on habitat.

Spirembolus abnormis, new species
Figures 120, 121, 123, 124, 125; Map 3

Holotype.–Male holotype from Wellington, Vancouver Island, British Columbia, October 1-15, 1951 (R. Guppy); deposited in AMNH.

Description.–Total length: female 1.9-2.1 mm, male 2.0 mm. Carapace: length: female and male 0.90-0.95 mm. Brown, with faint dusky markings and margins. Male carapace steeply raised (Fig. 124). Abdomen: grey to black. Sternum: brown, heavily suffused with black. Legs: orange-brown. Tibial spines: female 2221, male 0021. TmI: female 0.75-0.80, male 0.70-0.75. Male palp: Figs. 121, 125; the embolus forms a wide coil anteriorly. Female palp: tibia with 3 trichobothria. Epigynum: Figs. 120, 123.

Diagnosis.–The high value of TmI places this species in Section 5 of the Keys. The male of *S. abnormis* is separated clearly from the other species in the Section by the combination of the steeply raised carapace (Fig. 124) and the form of the palpal tibia (Fig. 125 cf. Figs. 106, 107, 109, 122). The female is readily distinguished from the other species by the epigynum (Fig. 120 cf. Figs. 104, 117). *S. abnormis* is smaller and less striking in color than *S. mundus* and *S. latebricola.*

Distribution.–The few records are from the western coastal area: California, Oregon and British Columbia (Map 3).

Natural History.–Males have been taken in April, September and October, females in July and October. Nothing is known on habitat.

Spirembolus tortuosus (Crosby in Chamberlin 1925), new combination
Figures 126, 127, 128, 129, 130, 131; Map 3

Tortembolus tortuosus Crosby in Chamberlin 1925: 116, Roewer 1942: 667; Bonnet 1958: 4663.

Holotype.–Male holotype from Stanford, California, 1920-1921; in MCZ, examined.

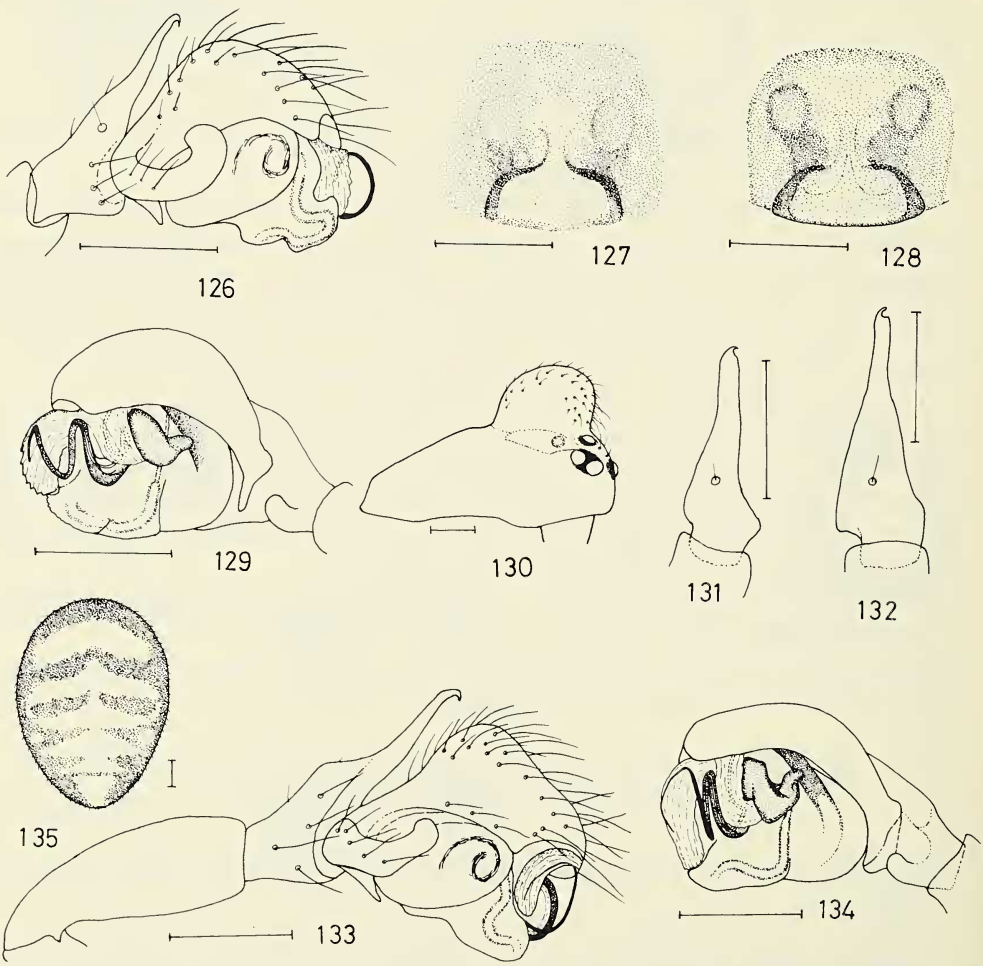
Description.–The female, which has been taken with the male, is described for the first time. Total length: female 1.30-1.40 mm, male 1.15-1.25 mm. Carapace: length: female 0.60-0.65 mm, male 0.55 mm. Brown to deep brown, with darker margins. Male carapace raised into large lobe with holes and sulci on sides (Fig. 130). Abdomen: grey to black. Epigastric plates smooth, without striae. Sternum: brown, suffused with black.

Legs: brown. Tibial spines: female 2221, male 0011. TmI: female 0.46-0.48, male 0.42-0.44. Male palp: Figs. 126, 129, 131; the embolus forms a small coil, and the tailpiece is rather compressed. Female palp: tibia with 2 trichobothria. Epigynum: Figs. 127, 128. The internal genitalia are close to those of *S. demonologicus*.

Diagnosis.—In the male, the large lobe on the carapace, coupled with the unicolorous abdomen and the absence of striae on the epigastric plates, distinguish *S. tortuosus* from all other species. The female falls into Section 6 of the Key; from the other species in this Section *S. tortuosus* is readily separated by the epigynum (Figs. 127, 128) and its relatively small size offers confirmation of identity.

Distribution.—Most of the records are from California, with one from Oregon (Map 3).

Natural History.—Males have been taken in October, November and January, females in September, October, December, January and February/March; the main period of maturity seems therefore to be in winter. Nothing is recorded on habitat.

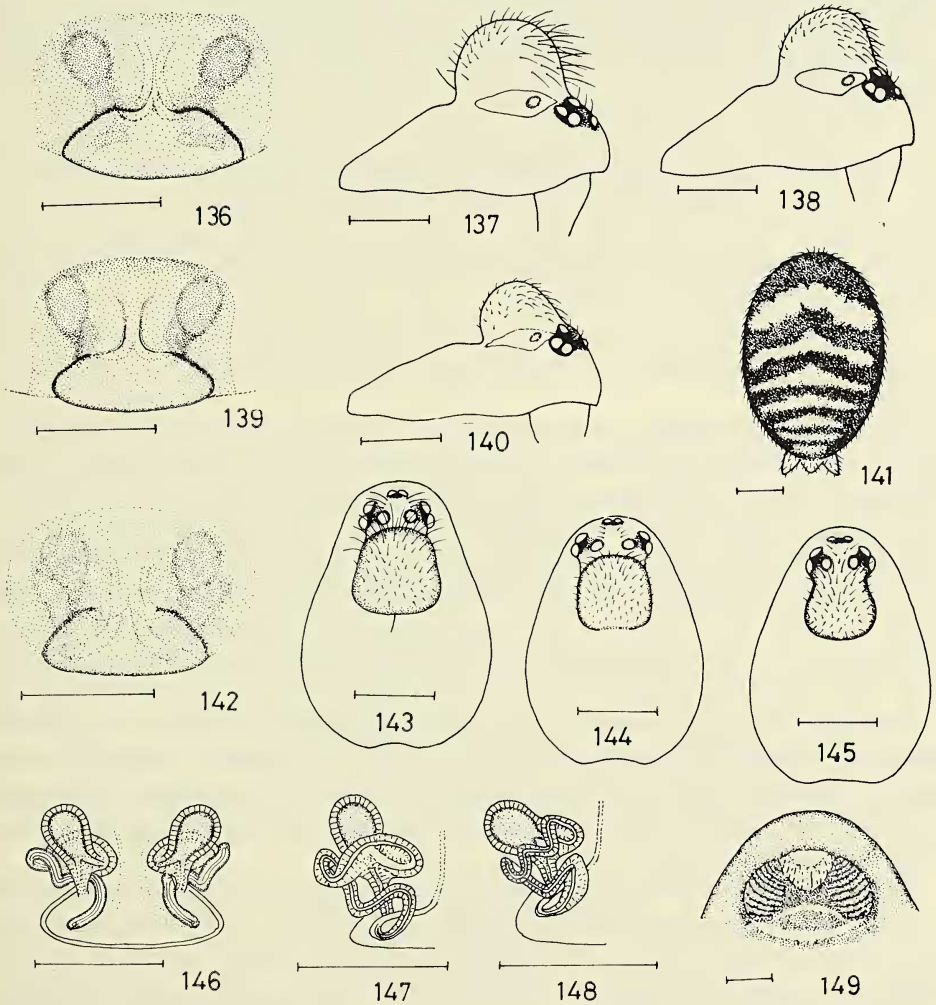


Figs. 126-135.—126, *S. tortuosus*, male palp, ectal; 127, *S. tortuosus*, epigynum; 128, *S. tortuosus*, epigynum (another specimen); 129, *S. tortuosus*, male palp, mesal; 130, *S. tortuosus*, male carapace, lateral; 131, *S. tortuosus*, male palpal tibia, dorsal; 132, *S. pusillus*, male palpal tibia, dorsal; 133, *S. pusillus*, male palp, ectal; 134, *S. pusillus*, male palp, mesal; 135, *S. fuscus*, abdomen, dorsal (Scale lines 0.1 mm).

Spirembolus fuscus, new species
Figure 135; Map 3

Holotype.–Female holotype from 4 miles west of Newcastle, California, April 1958 (I. M. Smith and R. Schuster); deposited in AMNH.

Description.–Only the female is known. Total length: female 1.25-1.30 mm. Carapace: length: female 0.60-0.65 mm. Deep brown with dusky margins. Abdomen: black, with bold white chevrons dorsally (Fig. 135); ventrally black, with any white markings not extending into central zone. Epigastric plates smooth. Sternum: deep brown, suffused with black. Legs: orange-brown. Tibial spines: very short and weak, and



Figs. 136-149.–136, *S. demonologicus*, epigynum; 137, 138, 140, *S. demonologicus*, forms of male carapace, lateral; 139, *S. demonologicus*, epigynum (another specimen); 141, *S. pusillus*, abdomen, dorsal; 142, *S. pusillus*, epigynum (one form); 143, 144, 145, *S. demonologicus*, forms of male carapace, dorsal; 146, *S. pusillus*, internal genitalia, ventral; 147, *S. pusillus*, half of internal genitalia, dorsal; 148, *S. levis*, half of internal genitalia, dorsal; 149, *S. pusillus*, epigastric plates, male (Scale lines 0.1 mm, except Figs. 137, 138, 140, 141, 143, 144, 145, 0.2 mm).

mostly missing from the available specimens. TmI: female 0.40-0.45. Female palp: tibia with 2 trichobothria. Epigynum: identical with that of *S. tortuosus*.

S. fuscus is very close to *S. tortuosus*, the only discernible difference being in the patterned abdomen. It is to be expected that the male of *S. fuscus* will have the cephalic lobe and palps virtually identical with those of *S. tortuosus*.

Diagnosis.—The patterned abdomen and the smooth epigastric plates place this species (female) with *S. fasciatus*, *S. levis* and *S. erratus*. The epigynum separates it at once from *S. fasciatus* and *S. erratus* (Fig. 127 cf. Figs. 155, 164). *S. fuscus* and *S. levis* have very similar epigyna, which are distinguishable when viewed side by side, but which may not be completely reliable for diagnosis. The significant difference in size (*S. fuscus* being much the smaller) may be the best means for separating these two species.

Distribution.—The species is known from two localities in California (Map 3).

Natural History.—The female were taken in December, March and April. Nothing is recorded on habitat.

Spirembolus demonologicus (Crosby in Chamberlin 1925), new combination
Figures 136,137,138,139,140,143,144,145; Map 3

Tortembolus demonologicus Crosby in Chamberlin 1925: 117; Roewer 1942: 667; Bonnet 1958: 4662

Holotype.—Male holotype from Berkeley, California, December 1919; in MCZ, examined.

Description.—The female, which was taken in company with the male, is described for the first time. Total length: female 1.6-1.75 mm, male 1.35-1.45 mm. Carapace: length: female and male 0.70-0.75 mm. Brown, with dusky margins. Male carapace raised into lobe, which has one of the 3 forms shown in Figs. 137, 138, 140; the holotype has the form shown in Fig. 137, which seems to be the commonest and is regarded as the "typical" form. Abdomen: grey. The epigastric plates have clear striae, fairly widely spaced in the male, somewhat more closely spaced in the female. Sternum: yellow to yellow-brown, with dusky margins. Legs: yellow-brown. Tibial spines: female 2221, male 0011. TmI: female 0.45-0.48, male 0.45. Male palp: this is identical with that of *S. pusillus* (Figs. 132, 133, 134); it is also very similar to that of *S. tortuosus*. Female palp: tibia with 2 trichobothria. Epigynum: Figs. 136, 139; this is identical with that of some forms of *S. pusillus*, and very close to that of *S. tortuosus*. The internal genitalia appear to be identical with those of *S. pusillus*, but the ducts are always less pigmented and consequently less easy to see.

Diagnosis.—The unicolorous abdomen and the presence of strong striae on the epigastric plates group this species with *S. monicus*. The male of *S. demonologicus* is distinguished clearly from *S. monicus* by the palpal organs, the embolic coil being small in *S. demonologicus* and very large in *S. monicus* (Fig. 134 cf. Fig. 170), and by the form of the carapace (Fig. 137, 138, 140 cf. Fig. 166). In the female, the genitalia give a clear separation between *S. demonologicus* and *S. monicus* (Figs. 136, 139 cf. Fig. 171). Care should be taken not to confuse *S. demonologicus* with *S. tortuosus*; the clear difference between these two species lies in the presence or absence of distinct striae on the epigastric plates.

Distribution.—Recorded from California, Oregon and Washington (Map 3).

Natural History.–Males have been taken in September, October, November, December and January, females in September, October, November and February; the main period of maturity seems therefore to be in autumn/winter. Nothing is recorded on habitat.

Spirembolus pusillus, new species
Figures 132,133,134,141,142,146,147,149; Map 3

Holotype.–Male holotype from Riverside, Riverside County, California, January 6, 1957 (I. Newell); deposited in AMNH.

Description.–Total length: female 1.40-1.60 mm, male 1.30-1.35 mm. Carapace: length: female 0.70-0.75 mm, male 0.70 mm. Orange-brown, with dusky markings and margins. Male carapace raised into 3 distinct forms (Figs. 137, 138, 140) exactly as in *S. demonologicus*; the holotype has the form shown in Fig. 137. Abdomen: black with clear white chevrons dorsally (Fig. 141); ventrally the white markings are almost absent. Both sexes with clear striae on the epigastric plates, fairly widely spaced in the male (Fig. 149), less widely spaced in the female. Sternum: brown, suffused with black. Legs: brown to orange-brown. Tibial spines: female 2221, male 0021. TmI: female 0.45-0.48, male 0.45-0.47. Male palp: Figs. 132, 133, 134. Female palp: tibia with 2 trichobothria. Epigynum: this is variable in appearance; often the ducts are clearly visible through the integument (Fig. 142), sometimes they are indistinctly visible (Fig. 136) or almost invisible. The degree of pigmentation of the sperm ducts is variable (Figs. 146, 147).

S. pusillus is very close to *S. demonologicus*, the only obvious differnece being in the patterned abdomen.

Diagnosis.–The patterned abdomen and the striated epigastric plates place *S. pusillus* with *S. erratus* (some specimens), *S. novellus* and *S. praelongus*. In the male, the small embolic coil immediately separates *S. pusillus* from the three species mentioned (Fig. 134 cf. Figs. 152, 161, 170), and the identity is confirmed by the form of the carapace and of the palpal tibia (note: the carapace (Fig. 138) can be very similar to that of *S. novellus*). The female of *S. pusillus* is separated from the other three species by the genitalia (Figs. 136, 142, 146 cf. Figs. 156, 160; 164, 165; 171, 172).

Distribution.–Known from a number of localities in California and one in Oregon (Map 3).

Natural History.–Males were taken in September, October, November, December and January, being most numerous in the two latter months; females occurred in all months except May, July, August and September. The chief season of maturity seems to be in winter. The only habitat recorded is in pyracantha litter at Davis, Yolo Co. (California).

Spirembolus levis, new species
Figure 148; Map 4

Holotype.–Male holotype from south of Hemet, California, November 10, 1957 (I. Newell); deposited in AMNH.

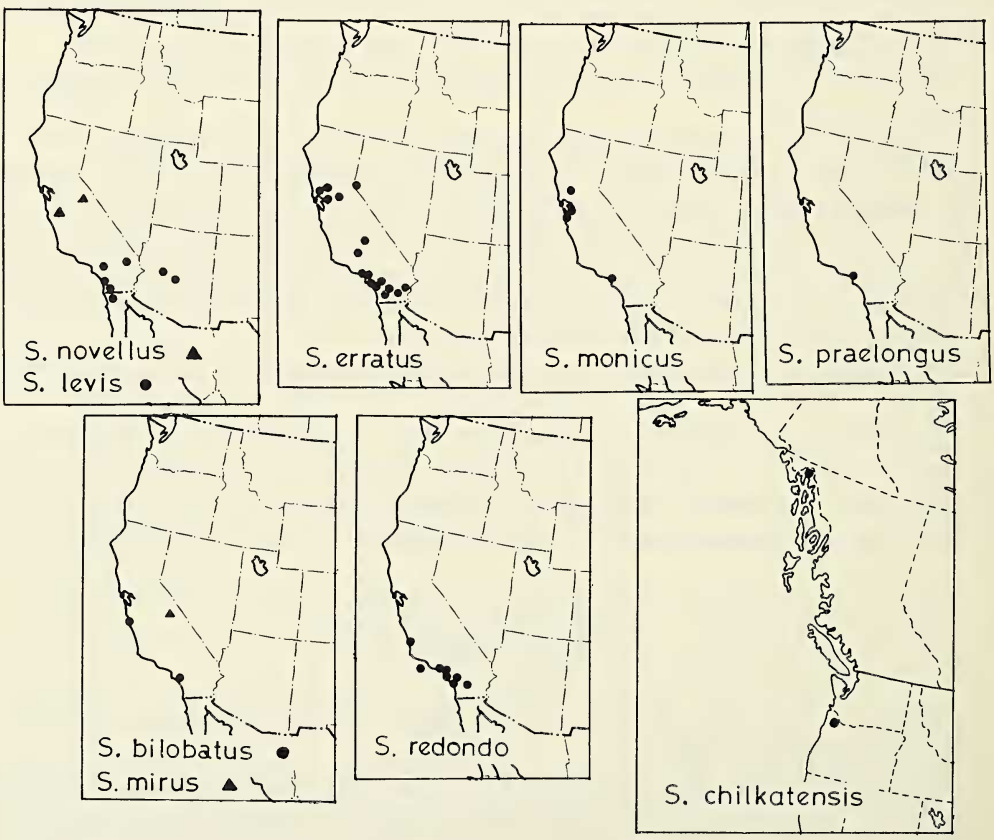
Description.–Total length: female 1.8-1.9 mm, male 1.45 mm. Carapace: length: female 0.75 mm, male 0.70 mm. Orange-brown, with dusky margins. Male with large lobe anteriorly, as in Fig. 137. Abdomen: grey-black with clear white chevrons dorsally; the white markings extend to the center of the ventral side. Epigastric plates smooth or with faint very closely spaced striae. Sternum: yellow to orange-brown, with blackish margins.

Legs: brown. Tibial spines: female 2221, male 0011. TmI: female 0.44-0.45, male 0.41-0.44. Male palp: not distinguishable from that of *S. pusillus* (Fig. 133). Female palp: tibia with 2 trichobothria. Epigynum: not distinguishable from that of *S. pusillus*. The sperm duct is more convoluted on the dorsal side of the spermatheca than in *S. pusillus* (Fig. 148 cf. Fig. 147).

Diagnosis.—The patterned abdomen and the absence of striae on the epigastric plates place *S. levis* with *S. fasciatus* in the male sex, and with *S. fasciatus, S. erratus* and *S. fuscus* in the female sex. In the male, the small embolic coil separates *S. levis* from *S. fasciatus* (Fig. 134 cf. Fig. 150), and the identity is confirmed by the form of the carapace and of the palpal tibia. In the female, the genitalia separate *S. levis* clearly from *S. fasciatus* and *S. erratus* (Fig. 142 cf. Figs. 155, 164). For the separation from *S. fuscus*, see that species. Care should be taken not to confuse *S. levis* with *S. pusillus*; these two species are separated solely by the presence or absence of striae on the epigastric plates.

Distribution.—This species has been found in California, Baja California and Arizona (Map 4).

Natural History.—Only two males are known, taken in March and November; females have occurred in February, March, April and November. It seems probable that the main maturity period is in winter. The only habitat recorded is in oak litter at San Bernadino Co., California.

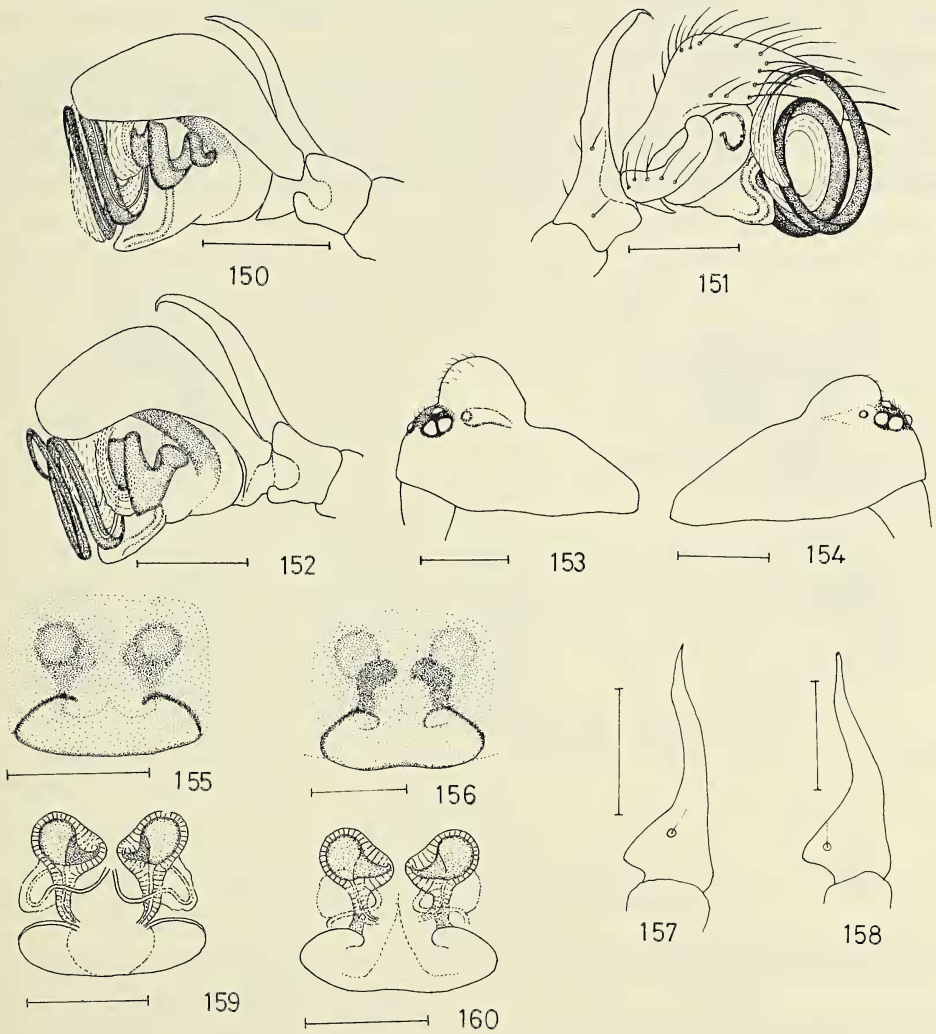


Map 4.—Western North America: distributions of *S. levis, S. novellus, S. erratus, S. monicus, S. praelongus, S. bilobatus, S. mirus, S. redondo* and *S. chilkatensis*.

Spirembolus fasciatus (Banks), new combination
Figures 150, 154, 155, 157, 159; Map 4

Lophocarenum fasciatum Banks 1904: 347
Tortembolus fasciatus: Crosby 1925: 115; Roewer 1942: 667; Bonnet 1958: 4662
Diplocephalus castigatorius Crosby 1905: 325, 1925: 115

Holotype.–Male holotype from Claremont, California (Baker); in MCZ, examined. This type is almost destroyed: only the carapace (without legs or palps) and a shrunken abdomen remain.

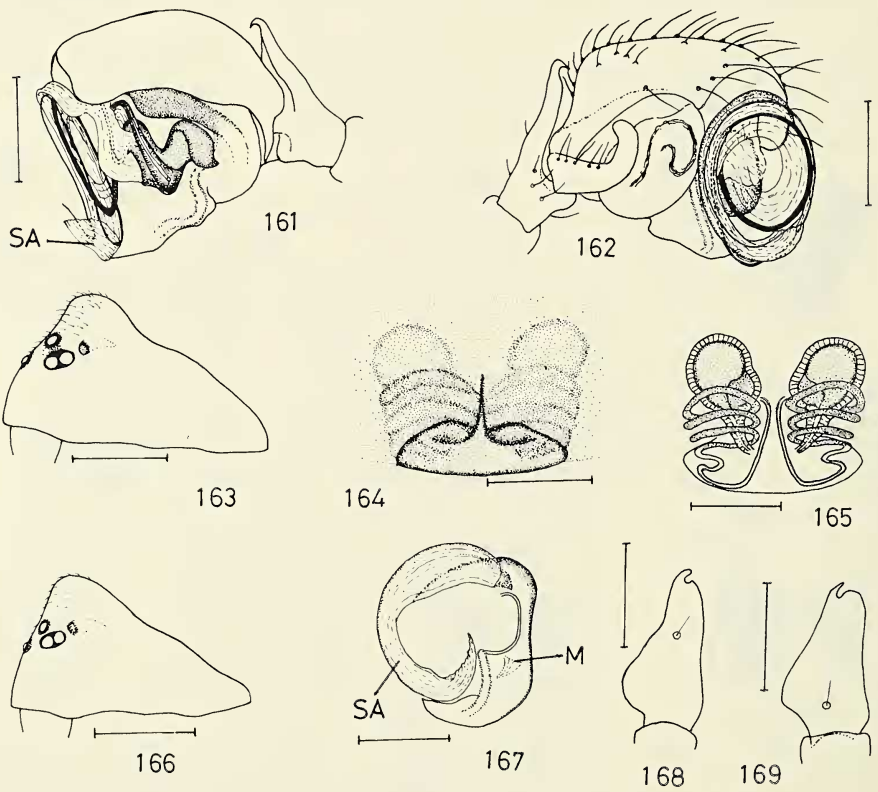


Figs. 150-160.–150, *S. fasciatus*, male palp, mesal; 151, *S. novellus*, male palp, ectal; 152, *S. novellus*, male palp, mesal; 153, *S. novellus*, male carapace, lateral; 154, *S. fasciatus*, male carapace, lateral; 155, *S. fasciatus*, epigynum; 156, *S. novellus*, epigynum; 157, *S. fasciatus*, male palpal tibia, dorsal; 158, *S. novellus*, male palpal tibia, dorsal; 159, *S. fasciatus*, internal genitalia, ventral; 160, *S. novellus*, internal genitalia, ventral (Scale lines 0.1 mm, except Figs. 153, 154, 0.2 mm).

Description.—The species here described agrees with the holotype in the form of the male head and in the virtual absence of striae on the epigastric plates, and is believed to be the true *S. fasciatus* (Banks). The types of *Diplocephalus castigatorius* (males) from AMNH were also examined, and their identity with the species described here was confirmed.

Total length: female 1.20-1.30 mm, male 1.25 mm. Carapace: length: female and male 0.55-0.60 mm. Yellow-brown. Male carapace raised into a fairly shallow lobe (Fig. 154). Abdomen: black, with white bars/chevrons dorsally, and a wide white bar ventrally just in front of the spinners. Epigastric plates normally smooth, but very faint striae are occasionally visible in the male. Sternum: yellow-brown with dusky margins. Legs: yellow-brown. Tibial spines: female 2221, male 0011 but spines weak. TmI: female 0.40, male 0.38. Male palp: Figs. 150, 157; embolic coil large. Female palp: tibia with 2 trichobothria. Epigynum: Figs. 155, 159.

Diagnosis.—The patterned abdomen and the virtually smooth epigastric plates group the male of *S. fasciatus* with *S. levis*, from which it is readily separated by the palps (Fig. 150 cf. Fig. 134) and the form of the carapace. The female of *S. fasciatus* falls into the same grouping as *S. levis, S. fuscus* and *S. erratus* (those specimens which have smooth



Figs. 161-169.—161, *S. erratus*, male palp, mesal; 162, *S. erratus*, male palp, ectal; 163, *S. erratus*, male carapace, lateral; 164, *S. erratus*, epigynum; 165, *S. erratus*, internal genitalia, ventral; 166, *S. monicus*, male carapace, lateral; 167, *S. erratus*, male palpal organ, anterio-mesal, ED removed; 168, *S. erratus*, male palpal tibia, dorsal; 169, *S. monicus*, male palpal tibia, dorsal. Abbreviations: M, membraneous apophysis; SA, suprategular apophysis (Scale lines 0.1 mm, except Figs. 163, 166, 0.2 mm).

epigastric plates); from these three species *S. fasciatus* is readily separated by the epigynum (Fig. 155 cf. Figs. 142, 127, 164). *S. fasciatus* is very close to *S. novellus* in both sexes; the chief distinction lies in the presence in *S. novellus* of clear epigastric striae, and the male carapace lobes are different (Fig. 154 cf. Fig. 153). There are also small differences in the palpal organs and in the epigyna (Fig. 155 cf. Fig. 156).

Distribution.–All the records are from California (Map 4).

Natural History.–The males have been taken in December, the females in January - June and in December. There is no information on habitat.

Spirembolus novellus, new species
Figures 151, 152, 153, 156, 158, 160; Map 4

Holotype.–Male holotype from Pinnacles National Monument, California, February 23, 1956 (G. A. March); deposited in AMNH.

Description.–Total length: female 1.75 mm, male 1.35 mm. Carapace: length: female and male 0.60 mm. Brown, with blackish margins. Male carapace raised into large lobe (Fig. 153). Abdomen: black, with white bars/chevrons dorsally, and a broad white chevron ventrally just anterior to spinners. Lung covers with striae in both sexes on epigastric plates, very closely spaced but rather weak in female, clear and closely spaced in male. Sternum: brown, suffused with black. Legs: brown. Tibial spines: female 2221, male 1111. TmI: female 0.42-0.45, male 0.41. Male palp: Figs. 151, 152, 158. The embolic coil is large in diameter. Female palp: tibia with 2 trichobothria. Epigynum: Figs. 156, 160.

Diagnosis.–The patterned abdomen and the striated epigastric plates place this species with *S. erratus* (those specimens which have striae), *S. praelongus* and *S. pusillus*. In the male, the form of the carapace separates *S. novellus* from *S. erratus* and *S. praelongus* (Fig. 153 cf. Figs. 163, 166), and confirmation is given by the form of the palpal tibia (Fig. 158 cf. Figs. 168, 169). *S. novellus* male is readily separated from *S. pusillus* by the larger diameter of the embolic coil (Fig. 152 cf. Fig. 134) and by the closely spaced striae in *S. novellus*. In the female, the genitalia are quite distinct from those of the other three species (Figs. 156, 160 cf. Figs. 142, 146; 164, 165; 171, 172). *S. novellus* is very close to *S. fasciatus* in both sexes: see *S. fasciatus* diagnosis.

Distribution.–Recorded from two localities in California only (Map 4).

Natural History.–The only male was taken in February, females in February and May. Nothing is known on habitat.

Spirembolus erratus, new species
Figures 161,162,163,164,165,167,168; Map 4

Holotype.–Male holotype from Laguna Beach, Orange County, California, December 28, 1932 (W. Ivie); deposited in AMNH.

Description.–Total length: female 1.35-1.45 mm, male 1.25 mm. Carapace: length: female 0.55-0.60 mm, male 0.55 mm. Yellow to orange-brown, with dusky markings and margins. Male carapace raised into small lobe (Fig. 163) with a small hole and sulcus behind each pair of lateral eyes. Abdomen: black, with white chevrons/bars dorsally; ventrally black with a broad lateral white stripe. The male has clear striae on epigastric plates, closely spaced but rather weak; in the female the striae are either absent or very weak. Sternum: yellow, suffused with black. Legs: yellow-brown. Tibial spines: female

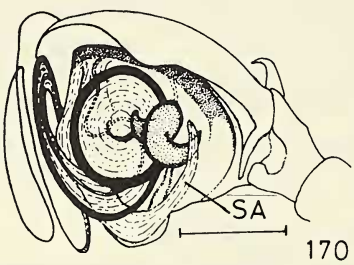
1111, male 0001, but weak in both sexes. TmI: female 0.37-0.40, male 0.35. Male palp: Figs. 161, 162, 168. The embolic coil is of large diameter. The palpal tibia is very similar to those of *S. monicus* and *S. praelongus*, and is somewhat different from the tibiae of the other species in the genus. Female palp: tibia with 2 trichobothria. Epigynum: Figs. 164, 165; the sperm duct forms a helix of several turns, a feature peculiar to *S. erratus, S. monicus* and *S. praelongus*.

No close relative of *S. erratus* having a unicolorous abdomen is known, but it seems probable that such a species may eventually be discovered.

Diagnosis.—The patterned abdomen and the striated epigastric plates group the male of this species with *S. novellus, S. pusillus* and *S. praelongus*. The form of the male carapace separates *S. erratus* from *S. novellus* and *S. pusillus* (Fig. 163 cf. Figs. 153, 137, 138, 140), and confirmation is given by the form of the palpal tibia (Fig. 168 cf. Figs. 158, 132) and by the palpal organs. The male of *S. erratus* is very similar to that of *S. praelongus*, being distinguished by the significantly larger diameter of the embolic coil in the latter (Fig. 161 cf. Fig. 174). In the female, the epigynum distinguishes *S. erratus* from all other species (except *S. praelongus*) which have a patterned abdomen. The epigyna of *S. erratus* and *S. praelongus* are very similar, but in the latter the spermathecae and ducts (partly visible through the integument) are more extended longitudinally and the spermathecae are rather smaller (Fig. 164 cf. Fig. 171).

Distribution.—Taken from a number of localities in California and from one locality in Nevada (Map 4).

Natural History.—Males have been taken in November, December, February and July (Nevada), females in all months except June, August, September and October. The main season of maturity may be in winter, at least in California. The only habitat recorded is in sycamore litter.



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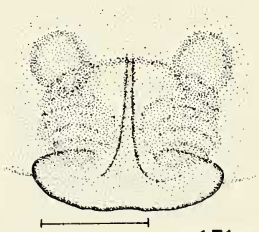

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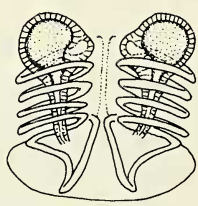

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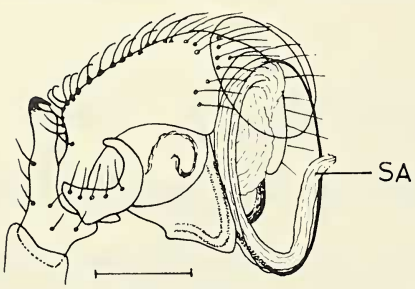

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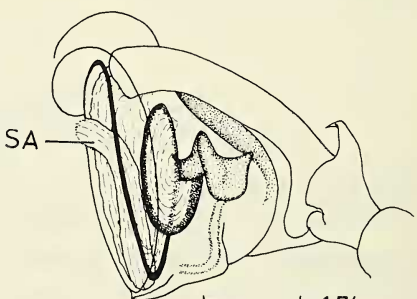

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Figs. 170-174.—170, *S. monicus*, male palp, mesal; 171, *S. monicus*, epigynum; 172, *S. praelongus*, internal genitalia, ventral; 173, *S. praelongus*, male palp, ectal; 174, *S. praelongus*, male palp, mesal. Abbreviation: SA, suprategular apophysis (Scale lines 0.1 mm).

Spirembolus monicus (Chamberlin), new combination
Figures 166, 169, 170, 171; Map 4

Tortembolus monicus Chamberlin 1948: 558

Holotype.—Female holotype from Santa Monica, California, December 19, 1933 (W. Ivie); in AMNH, examined.

Description.—The male, which is described for the first time, was not taken in company with a female of *S. monicus*, but its characters indicate that it almost certainly belongs to this species. Total length: female 1.30 mm, male 1.0 mm. Carapace: length: female 0.55 mm, male 0.50 mm. Orange-brown, with dusky markings and margins. The male carapace rises steeply, with a small hole and sulcus behind the lateral eyes (Fig. 166). Abdomen: grey-black. Epigastric plates with striae, strong and quite widely spaced in male, weaker and less widely spaced in female. Sternum: yellow, suffused with black. Legs: pale orange-yellow. Tibial spines: lost from all specimens. TmI: female 0.35, male 0.33. Male palp: Figs. 169, 170; the embolus is very thin and hair-like distally, forming a coil of such wide diameter that the whole palpal organ appears slightly distorted on the mesal side. The SA is long, extending well onto the mesal side. Female palp: tibia with 2 trichobothria. Epigynum: Fig. 171; the outline of the ducts is sometimes indistinct. The internal genitalia are similar to those of *S. praelongus* (Fig 172), the sperm duct forming a coil of several turns.

Diagnosis.—The unicolorous abdomen and the striated epigastric plates place this species with *S. demonologicus*. In the male these two species are readily separated by the palpal organs (Fig. 170 cf. Fig. 134) and by the carapace lobes, as well as by the considerable difference in size. The females of these two species are clearly separated by their epigyna (Fig. 171 cf. Figs 136, 139). *S. monicus* should not be confused with *S. praelongus*, which has closely similar sex organs but a patterned abdomen.

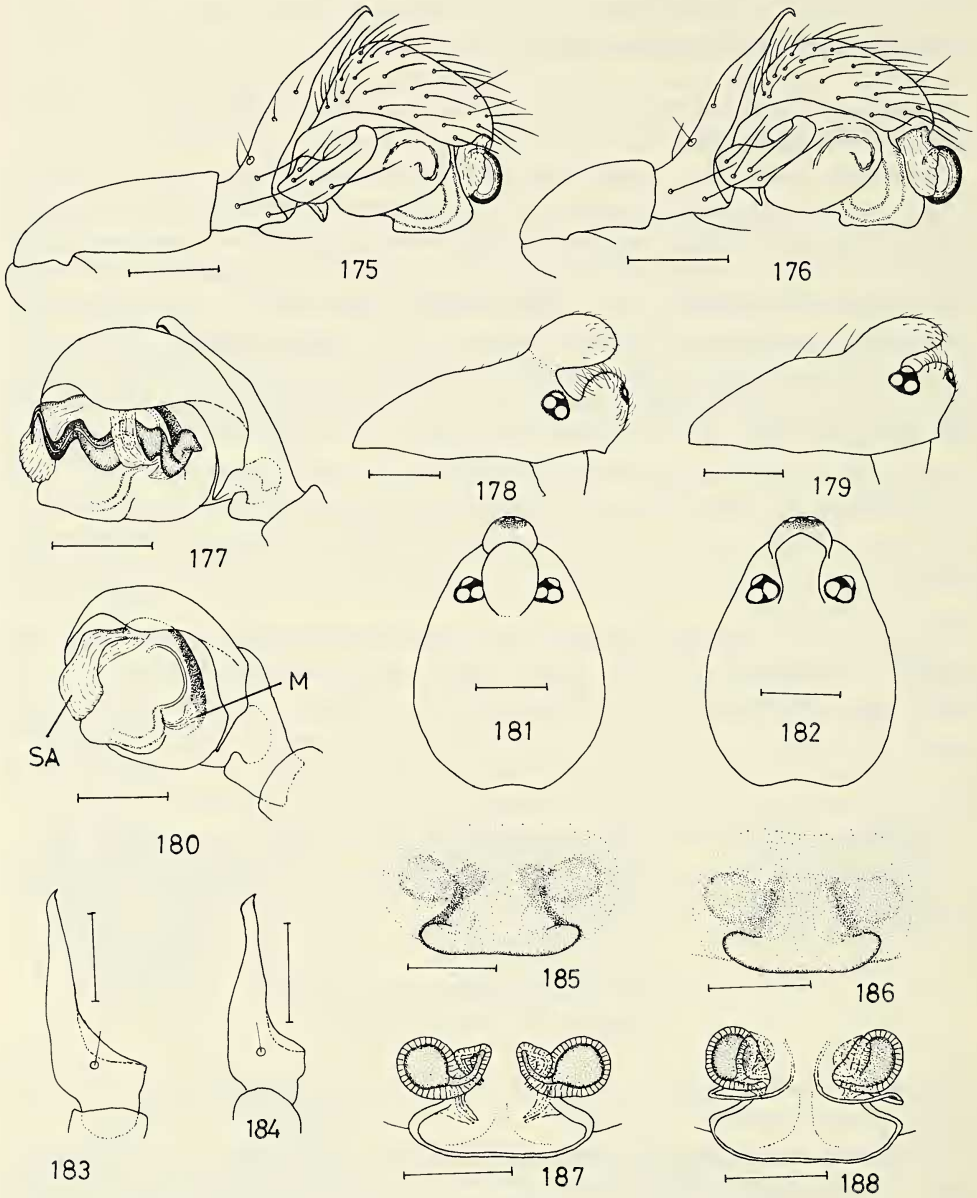
Distribution.—Known from three localities in California (Map 4).

Natural History.—The only male was taken in February, the females in December and January. The habitat was not recorded.

Spirembolus praelongus, new species
Figures 172, 173, 174; Map 4

Holotype.—Male holotype from Santa Monica, California, December 19, 1933 (W. Ivie); deposited in AMNH.

Description.—Total length: female 1.25-1.35 mm, male 1.10-1.15 mm. Carapace: length: female and male 0.50-0.55 mm. Yellow-brown, with dusky markings and margins. Male carapace similar to that of *S. monicus*. Abdomen: dorsally grey-black with clear white chevrons, the white markings extending to the ventral side. Epigastric plates with striae, strong and fairly widely spaced in male, weak and closely spaced in female. Sternum: yellow with dusky margins. Legs: yellow-brown. Tibial spines: female 1111, weak; missing in male. TmI: female 0.40, male 0.36. Male palp: Figs. 173, 174. The embolus is very thin and hair-like distally, forming a coil of large diameter. The SA is very long. Female palp: tibia with 2 trichobothria. Epigynum: similar to that of *S. monicus*, but the internal ducts are more clearly visible; the sperm duct (Fig. 172) forms a coil of several turns.



Figs. 175-188.–175, *S. bilobatus*, male palp, ectal; 176, *S. redondo*, male palp, ectal; 177, *S. bilobatus*, male palp, mesal; 178, *S. bilobatus*, male carapace, lateral; 179, *S. redondo*, male carapace, lateral; 180, *S. bilobatus*, male palpal organ, mesal, ED removed; 181, *S. bilobatus*, male carapace, dorsal; 182, *S. redondo*, male carapace, dorsal; 183, *S. bilobatus*, male palpal tibia, dorsal; 184, *S. redondo*, male palpal tibia, dorsal; 185, *S. bilobatus*, epigynum; 186, *S. redondo*, epigynum; 187, *S. bilobatus*, internal genitalia, ventral; 188, *S. redondo*, internal genitalia, ventral. Abbreviations: M, membraneous apophysis; SA, suprategular apophysis (Scale lines 0.1 mm, except Figs. 178, 179, 181, 182, 0.2 mm).

S. praelongus is closely similar to *S. monicus*, the chief difference being the patterned abdomen.

Diagnosis.–From all other species with a patterned abdomen, *S. praelongus* is readily separated by the palp in the male and by the epigynum in the female. Confusion is possible only with *S. erratus*. The male of *S. praelongus* is distinguished quite easily from *S. erratus* by the larger diameter of the embolic coil (Fig. 174 cf. Fig. 161), but the females present more difficulty. The genitalia of the two species are very similar, but in *S. praelongus* the spermathecae are somewhat smaller and the internal organs are more extended longitudinally (Figs. 171, 172 cf. Figs. 164, 165). *S. praelongus* should not be confused with *S. monicus*, which is very similar apart from the unicolorous abdomen.

Distribution.–Known only from the type locality (Map 4). The four males and five females (holotype and paratypes) were taken at the same time and in the same locality as *S. monicus* and *S. erratus*; in the AMNH material these specimens were mixed with *S. erratus* in a vial labelled "*Tortembolus fasciatus*".

Natural History.–Both sexes were taken in December. Nothing was recorded on habitat.

Spirembolus bilobatus (Chamberlin and Ivie), new combination
Figures 175, 177, 178, 180, 181, 183, 185, 187; Map 4

Bactroceps bilobatus Chamberlin and Ivie 1945: 224

Holotype.–Male holotype from Pacific Grove, California, September 1, 1937 (W. Ivie); in AMNH, examined.

Description.–Total length: female 1.8-2.0 mm, male 1.5-1.7 mm. Carapace: length: female 0.85-0.90 mm, male 0.75-0.80 mm. Chestnut-brown, with dusky markings and margins. Male carapace raised into distinct lobes (Figs. 178, 181). Abdomen: grey to black. Sternum: brown, suffused fairly heavily with black. Legs: brown Tibial spines: female 1111, male 0011. TmI: female and male 0.52-0.57. Male palp: Figs. 175, 177, 180, 183. The embolus is short and stout, in a small coil. Female palp: the number of trichobothria on the tibia is not constant, being 2 or 3 on either palp. Epigynum: Figs. 185, 187.

Diagnosis.–The male of *S. bilobatus* is recognizable at once by the form of the head, which is sufficiently distinct from that of *S. redondo* to make confusion unlikely (Figs. 178, 181 cf. Figs. 179, 182); confirmation is given by the palp, which is very similar to that of *S. redondo* but has the patella somewhat longer (Fig. 175 cf. Fig. 176). The female of *S. bilobatus* is distinguishable from most of the other species by the epigynum; only the epigyna of *S. redondo* and of *S. whitneyanus* could be confused with *S. bilobatus* (Fig. 185 cf. Figs. 186, 93), but distinction from these two species is given by the tibial spines (1111 in *S. bilobatus* female, 2221 in *S. redondo* and in *S. whitneyanus*.).

Distribution.–Known only from California (Map 4).

Natural History.–Numerous males and females have been taken in September, which seems to be the main period of maturity, and a female has also been found in December. The types were sifted from leaves from under shrubs at the edge of a sand dune (Pacific Grove, California).

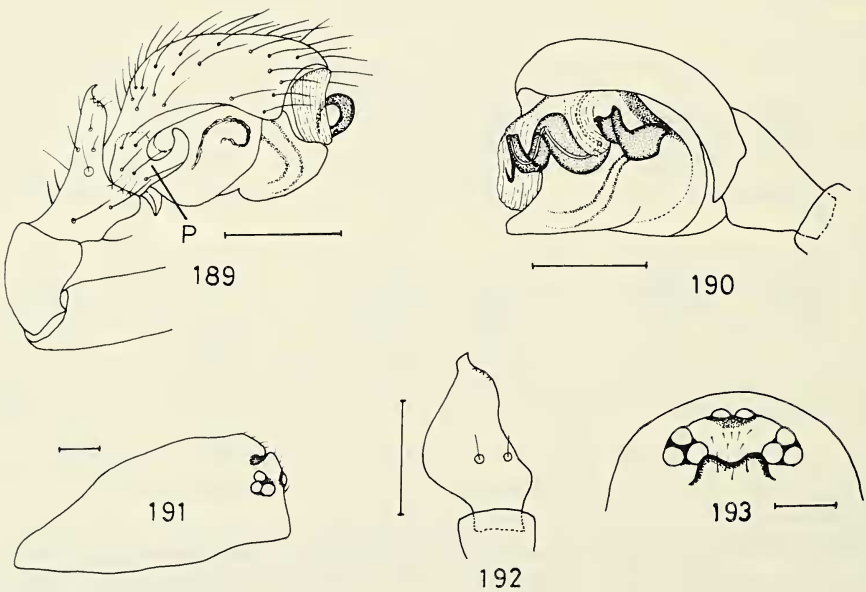
Spirembolus redondo (Chamberlin and Ivie), new combination
Figures 176, 179, 182, 184, 186, 188; Map 4

Bactroceps redondo Chamberlin and Ivie 1945: 225

Holotype.—Male holotype from 2 miles south of Redondo Beach, California, March 18, 1941 (W. Ivie); in AMNH, examined.

Description.—Total length: female 1.55-1.70 mm, male 1.35-1.50 mm. Carapace: length: female 0.70-0.75 mm, male 0.70 mm. Brown to deep brown with dusky markings and margins. Male carapace raised into distinct lobes (Figs. 179, 182). Abdomen: grey to black. Sternum: brown, suffused with black. Legs: yellow to brown. Tibial spines: female 2221, male 0021. TmI: female 0.48-0.54, male 0.45-0.47. Male palp: Figs. 176, 184; palpal organs almost identical with those of *S. bilobatus*. Female palp: the number of trichobothria on the tibia is not constant, being 2 or 3 on either palp. Epigynum: Figs. 186, 188.

Diagnosis.—The male of *S. redondo* is recognizable at once by the form of the head, which is sufficiently distinct from that of *S. bilobatus* to make confusion unlikely (Figs. 179, 182 cf. Figs. 178, 181); confirmation is given by the palp, which has the patella relatively shorter than in *S. bilobatus* (Fig. 176 cf. Fig. 175). The female of *S. redondo* is distinguishable from most other species by the epigynum; only the epigyna of *S. bilobatus* and *S. whitneyanus* could be confused with *S. redondo* (Fig. 186 cf. Figs. 185, 93). *S. redondo* female is separable from *S. bilobatus* by the tibial spines (2221 in *S. redondo*, 1111 in *S. bilobatus*). The epigynum of *S. whitneyanus* though close is usually distinguishable, and these two species also show differences in the stoutness of the legs: e.g. tibia I 1/d is ca. 6 in *S. redondo* and 4-4.5 in *S. whitneyanus*.



Figs. 189-193.—189, *S. mirus*, male palp, ectal; 190, *S. mirus*, male palp, mesal; 191, *S. mirus*, male carapace, lateral; 192, *S. mirus*, male palpal tibia, dorsal; 193, *S. mirus*, anterior of male carapace, dorsal. Abbreviation: P, paracymbium (Scale lines 0.1 mm).

Distribution.–Known only from California (Map 4).

Natural History.–Males have been taken in March, September and October, females in January, March, April, September, October, November and December. The main period of maturity is probably in autumn and winter. The types were sifted from leaves taken under shrubs.

Spirembolus mirus, new species
Figures 189, 190, 191, 192, 193; Map 4

Holotype.–Male holotype from 9 miles west of Bishop, California, May 12, 1959 (L. M. Smith); deposited in AMNH.

Description.–Only the male is known. Total length: male 1.50 mm. Carapace: length: male 0.70 mm. Brown; there is a small lobe behind the eyes, and a hole behind the lateral eyes (Figs. 191, 193). Abdomen: grey. Eyes: in a *Pholcomma*-like arrangement (Fig. 193). Sternum: pale yellow. Legs: pale brown to brown. Tibial spines: male 0011. Tml: male 0.35-0.40. Male palp: Figs. 189, 190, 192. Embolus short and stout, in a small coil.

Diagnosis.–This species is recognizable at once in the male by the small lobe behind the eyes, coupled with the form of the palp.

Distribution.–Known only from the holotype and two paratype males (Map 4).

Natural History.–The males were taken in May. Nothing was recorded on habitat.

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